THE TREASURES OF THE EARTH

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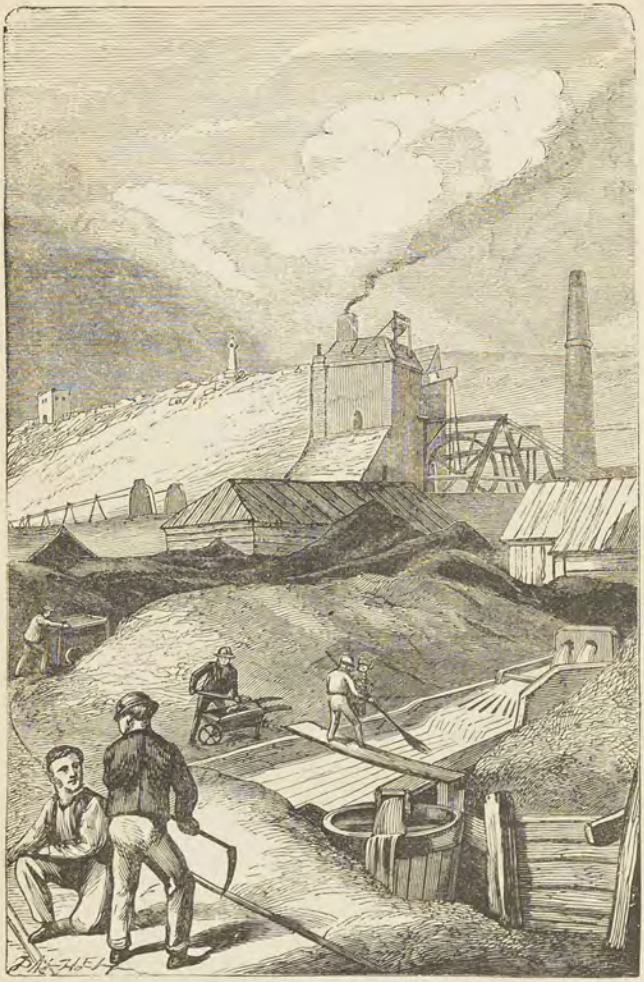

A CORNISH MINE. [*Frontispiece.*

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THE TREASURES OF THE EARTH:

OR,

MINES, MINERALS, AND METALS.

BY

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WITH ORIGINAL ILLUSTRATIONS.

LONDON AND NEW YORK:
FREDERICK WARNE AND CO.

LONDON:
BRADBURY, AGNEW, & CO., PRINTERS, WHITEFRIARS.

PREFACE.

WHEN Gustavus Adolphus, King of Sweden, wished to descend into the copper mines at Falun, his courtiers begged him not to risk his life. "A king," he replied, "is not worth a straw, who does not look into his *treasury*." On arriving at a freshly-hewn chamber, where the copper ore shone bright and glittering, he exclaimed, "What should such a potentate be who possesses a palace like this!"

These were the wise words of a great monarch who could appreciate the bounty of Providence in storing up the "treasures of the earth" for the welfare of his people.

I have endeavoured, in the following pages, to blend amusement with instruction, and thus initiate the youthful reader into the "mysteries" of mining; for to many persons, irrespective of age, such pursuits have this character. The subject is interesting from every point of view, especially when we consider that upon our mining resources, and the progress of our manufactures, depends, in a great measure, the commercial superiority of our country.

In relating visits to mines, the treatment of metals and minerals, and the various uses to which they are applied, I have avoided, as much as possible, all technicalities, or I have simplified them so as to be readily understood by the uninformed reader.

I have added some brief sketches of remarkable persons, who have been connected with mining pursuits, as examples to the rising generation of what steadiness, perseverance, and talent can achieve in the walks of industry :—

> " What simple Nature yields
> (And Nature does her part) are only rude
> Materials, cumbers on the thorny ground :
> 'Tis *toil* that makes them wealth."

PREFACE TO THE SECOND EDITION.

THE following work, originally intended for a limited circle of young readers, has received, within a few months, the honour of a second edition. I have been, consequently, enabled to insert three additional chapters, viz., " On Precious Stones, and Superstitions connected with them," " Crowns," and " Common Stones."

I have also added to the sketches of " Eminent Men who have been connected with Mining," a few other names, conspicuous in the annals of science for their valuable assistance to mining interests.

W. J.

BROADGATE,
BARNSTAPLE.

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THE

TREASURES OF THE EARTH.

CHAPTER I.

THE PRECIOUS METALS.

ALL records point to GOLD and SILVER as the earliest metals known. The Scriptures, the most ancient writings we possess, abound with notices of them. You will remember that gold is mentioned in the second chapter of Genesis as in use, and familiarly known before the flood: "The name of the first is Pison, that is it which encompasseth the whole land of Havilah, where there is gold. And the gold of that land is good." The Hebrew word for gold is *zeb*, signifying to be clear, to shine; alluding, doubtless, to the brilliancy of that metal. The term *gold* occurs frequently in the writings of Moses, and that metal must have been in common use among the Egyptians when Moses led the children of Israel out of Egypt, which is generally believed to have been one thousand six hundred and forty-eight years before the commencement of the Christian era.

Silver, also, was not only familiarly known to the Egyptians in the time of Moses, but, as we learn in the Book of Genesis, it was coined into money before Joseph was set over the land of Egypt by Pharaoh, which happened eight hundred and seventy-two years before Christ, and consequently two hundred and twenty-four years before the departure of the children of Israel from Egypt.

If you refer to the forty-seventh chapter of Genesis, you will find that "Joseph gathered up all the money that was found in the land of Egypt, and in the land of Canaan, for the corn which they bought; and Joseph brought the money into Pharaoh's house." The Hebrew word *kemep*, translated *money*, signifies silver, and was so called from its pale colour. You will recollect that after the departure of the children of Israel from Egypt the gold ear-rings of the females were sufficient to form the golden calf which was impiously worshipped, and that the contributions levied on the males, for ornamenting the temporary tabernacles in the wilderness, amounted to a large sum, equal, in our days, to two hundred thousand pounds.

Again, when Gideon defeated the Midianites, we find that he collected the ear-rings of the conquered, which amounted in value to nearly five thousand pounds of our money. In the wars which the Jews sustained with the nations that lay between the desert and the land of Canaan, they were very careful in preserving the gold and silver found among their heathen opponents. At Jericho the precious metals were deposited in the public treasury.

The "Book of Kings" contains frequent mention of the gold of Ophir, a region from which the ships of Solomon (fitted out in the harbours of Edom) brought gold. The voyage occupied three years. Where Ophir was situated has been much debated; Josephus, the

Jewish historian, places it in the peninsula of Malacca. Solomon employed the gold thus obtained in ornamenting the interior of the temple at Jerusalem, and a wonderful building this must have been, unequalled for beauty and richness. It is said that this great king "overlaid the house within with pure gold, and made a partition by the chains of gold before the 'oracle;' and he overlaid the oracle with gold, and the whole house he overlaid with gold, till he had furnished the whole house; also the whole altar, that was by the oracle, he overlaid with gold." We also learn from the Bible that all the utensils of Solomon were of gold, which was nothing accounted of in those days.

I will now relate to you through what source the precious metals were chiefly distributed. Phœnicia (so called from its abounding in date trees) and in the time of Solomon had risen into great power and opulence, comprehended but a very narrow tract of land between Mount Libanus and the sea, bounded by the Mediterranean on the west, by Syria to the north and east, and Judæa to the south. Its length may be said to have been two hundred miles, whilst its breadth never exceeded twenty miles. Phœnicia did not constitute one single state, but consisted of several cities, connected by a federation, at the head of which stood Sidon, the greatest maritime city in the ancient world, frequently mentioned in the histories of Moses and Joshua; and Tyre, its rival, styled in Joshua the "strong city."

The Phœnicians, the great trading people in the early ages, were famous for their knowledge of metals. Their mining operations in the Lebanon and Cyprus, where they dug for copper; in Thasos, one of the Thracian Islands, where, according to Herodotus, they overturned a whole mountain in searching for gold; but more particularly in Iberia or Spain, where at first silver was so abundant that scarcely any labour was required to obtain it, were stupendous. The minute description of the mining process contained in the Book of Job (xxviii. 1—11) was probably derived from a sight of their work. The artists sent by Hiram from Sidon to Solomon were, we are told, skilful workers in gold and silver.

The abundance of the precious metals among the Phœnicians was so great that the account reads more like a fable than a reality. When the mines of Spain were first discovered by them, not having room to store away all the silver in their vessels, they are said to have made even their anchors of that metal. The great wealth of these mines is clear, from the fact that even in the time of the Romans forty thousand men were continually employed upon them.

It has been observed, from the relics of the ancient inhabitants of Spain and other countries—as shown in the Museum at Copenhagen, for instance—that in many tools and weapons gold is profusely employed, and iron seems to have been scantily used. In that museum are swords, daggers, and knives, the blades of which are gold, whilst an edge of iron is formed for the purpose of cutting.

So immense in ancient times was the quantity of gold and silver, that it is difficult to credit what is related by some historians. The total value of the precious metals and other treasures contained in the Temple of Belus at Babylon has been computed to exceed £120,000,000,000 sterling of our own money. The gold and silver taken by Cyrus in the conquest of Asia was £126,224,000. We are also told that the treasures collected by the kings of Persia were enormous, and that Alexander, having conquered that empire, drew from it annually to the amount of £67,500,000; probably this was not all gold, though, no doubt, there was a great quantity of this metal.

Gold and silver would thus appear to have been plentiful in ancient times, and were probably accumulated in greater quantities in certain localities than at present.

"Rich as Crœsus" has become a proverb. It does not prove however, that the acquisition of wealth, for money's sake, can, in any manner, make us happier or more contented, but, on the contrary, it often proves a source of misery and anxiety, and is more frequently a curse than a blessing. In the case of Crœsus, his riches (which are said to have amounted in value to a million and a half sterling of our money) were the cause of his misfortunes. He was the last king of Lydia, in Asia Minor (560 years before Christ), and became a powerful monarch. By his conquests, his mines, and the golden sands of the river Pactolus (which flowed through his lands), he accumulated vast treasures, and gave himself up to sumptuous extravagance. Having everything to gratify his desires, he is said to have considered himself the happiest man in the world, and to have been displeased when Solon, one of the wise men of Greece, told him that no man should be called happy until his death. He soon found out how uncertain was such happiness as his, for his beloved son Atys was killed while hunting, and there was left to him only one son, who was dumb. Having engaged in war with Cyrus, the founder of the Persian monarchy, he was totally defeated, his kingdom conquered, and himself made prisoner, and condemned to be burnt. At the funereal pile his repeated exclamation of "Oh, Solon!" drew on him the attention of Cyrus, and the reason being explained, his life was spared. The story I have related to you is true, and that which I now mention, although fabulous, will serve to show how vain are our aspirations for riches, and how little is our contentment in possessing them. How much better was the prayer of king Solomon for what is more precious than all the treasures of gold and silver,—"an understanding heart" to judge rightly in the sight of God!

In the early part of the life of Midas, king of Phrygia, in Asia Minor, it is related that he found a large treasure, to which he owed his greatness and opulence. The hospitality he showed to Silenus, the preceptor of Bacchus, the heathen god of wine, who had been brought to him by some peasants, was liberally rewarded; and Midas, when he conducted the old man back to the god, was permitted to choose whatever recompence he pleased. He had the imprudence and the avarice to demand of Bacchus that whatever he touched might be turned into gold. His prayer was granted, but he was soon convinced of his unwise choice, and when the very meats which he attempted to eat became gold in his mouth he begged Bacchus to take back a present so fatal to the receiver. He was ordered to wash himself in the river Pactolus, whose sands, it is pretended, were turned into gold by the touch of Midas.

"Gold, gold, money untold!"
Cried Midas to Bacchus, beseeching.
Said the god, "I'm afraid,
By the prayer you have made,
You are vastly too overreaching.
But the gold I will grant,
Ay, more than you want."
Said Midas, "My coffer
Holds more than your offer,
So grant me the treasure without stint or measure."

Gold, gold, money untold,
King Midas found came to his wishes;
· Wherever he trod,
Rich gold was the sod,
Gold covered his meat and his dishes!
No mint more prolific,
His touch was specific,
And turned all to ore that was gold to the core.

Gold, gold, money untold!
"Alas!" cried the monarch, confounded,
"I would rather, I think,
Have good victuals and drink
Than be with such metal surrounded.
Mighty Bacchus, I pray
Let your gift pass away,
For gold, of itself, can no hunger allay!"

"Gold, gold, money untold,"
Said the god to the penitent miser,
"Is a gift of no worth
To the children of earth,
Nor makes them the better or wiser!
But a way I'll unfold
To wash off your gold,
If you wish me to be your adviser."

"Gold, gold, money untold,
To be rid of you I will endeavour."
So the king laid aside
Both his robes and his pride,
And plunged into Pactolus river.
From his skin fell away
All the gold, strange to say,
And is left in the sands there for ever!

Few, comparatively speaking, have enriched themselves by gold-finding: the very circumstance of getting money so easily excites to extravagance, and from this cause many, through whose hands much wealth has passed, have left off as poor as when they commenced.

As you grow up and enter into the busy affairs of life, you will soon find out what an influence for good, but more frequently for evil, gold exercises over the mind, and how often the best affections of our nature are sacrificed to avarice. I remember a story in which this is strikingly exemplified, with the retribution that always overtakes sordid people. It is one instance, out of many thousands of a similar character, that mark the world's history.

Olaf Bager was a rich merchant of Odense, in Denmark, and a man of noble and generous sentiments. He lent money to his king, Frederick the Second, who, when he visited Odense, never failed to sup at the house of his friend and subject. One night, at supper, the king praised highly some conserves of apricots. "What a sweet smell they have too!" he added. "Wait, my liege," replied Bager, "until the dessert. I will give you some incense that will please you far better."

When supper was over, an incense-burner was brought, laden with perfumed cedar chips, on the top of which was laid a mass of papers.

"Will your Majesty deign to light the pile?" requested Bager, offering a match. The king did so most graciously, and with quiet satisfaction saw reduced to powder his own bonds for sums so enormous that he had little hope of paying the debt.

Time rolled on, and Bager had a numerous family. He portioned his daughters, and established his sons in business. Through some inevitable misfortunes, however, the merchant became ruined, and had like King Lear, mentioned in Shakspere, to go to his children for help and refuge, but they treated him badly. "He had much better," said they, "have kept his bonds instead of ruining himself for his sovereign's sake, and becoming a burden to his family."

Olaf, sick at heart, and in want of the common necessaries of life, felt deeply grieved, as you may imagine, at this unnatural conduct of his children, but he thought of an expedient to punish them, and to provide himself at their expense with what he needed. He went round to his various friends, and to merchants with whom he had had dealings, and returned with a heavy coffer, which he deposited in a place of safety, well closed with wrought-iron lock and key. He gave out that he had received gifts from some, and had recovered various debts long due. The contents of the box he intended to leave to the son or the daughter who treated him best.

It was wonderful to see now how ready and even zealous the children of Olaf Bager were to relieve their father. There was a constant rivalry between them who should receive him best and attend to his wants. The comforts of life were showered upon him, and he was the object of the most filial solicitude. Amidst this prodigality of affection old Bager at length ended his days in peace, but not before he had addressed his children on the treasures he was about to leave them. He could make no distinction among them; all his "dutiful" children had been kind to him, so the contents of the coffer were to be equally divided among them. There would be enough for all.

Olaf Bager was conducted in pomp and honour to his last resting-place, followed by his *sorrowing* children. Afterwards the will was read, the coffer opened, and it was found to be full of *stones*.

This, you will say, was a just requital for avarice and undutiful behaviour.

An old writer says,—

> "Woe to the man that first did dig the ground
> To find the mines of silver and of gold!
> For when it lay hid, and unto us unknown,
> Of strife and debate the seed was unsown.
> Then lived men well, and held themselves content
> With food and cloth, and payèd then no rent."

A story is related by one of the early Italian novelists to show the evil consequences of greediness of money; it is entitled, "How a certain hermit on his way through a forest found a great treasure, and what he did with it."

A gentle hermit, one day, proceeding on his way through a vast forest, chanced to discover a large cave nearly hidden underground. Being much fatigued, he entered to repose himself awhile; and observing something shining in the distance, he approached, and found it was a heap of gold. At the sight of the glittering bait he turned away, and hastening through the forest again as fast as possible, he had the misfortune to fall into the hands of three fierce robbers, always on the watch to despoil the unwary travellers who might pass that way. But though living in the forest, they had never discovered the treasure from which the hermit now fled. The thieves on thus seeing him so strangely flying, without any one in pursuit, were seized with a sort of unaccountable dread, though at the same time they ventured forward to ascertain the cause. On approaching to inquire, the hermit, without relaxing his pace, answered, "I am flying from death, who is urging me sorely behind." The robbers, not perceiving any one, cried out, "Show us where he is, or take us to the place instantly." The hermit therefore replied, in a hurried voice, "Follow me then," and proceeded towards the grotto. He there pointed out to them the fatal place, beseeching them at the same time to abstain from looking at it. But the thieves, resolving to know what strange thing had alarmed him, bade him lead the way, which, being in terror of his life, the hermit quickly did, and showed them the heap of gold. "Here," he said, "is the death that was in pursuit of me;" and the thieves, seizing upon the treasure, began to rejoice exceedingly. They afterwards permitted the good man to proceed on his way, amusing themselves by ridiculing his strange conduct. At length they began to consider what they should do with the gold. One of them observed, "We ought not to leave the place with out taking this treasure with us." "No," replied another, "we had better not do so; but let one of us take a small portion, and set out to buy wine and meat in the city, besides many other things we are in need of;" and to this the other two consented. Now the evil spirit, who is always busy on these occasions, directly began to tempt the robber who was to go into the city. "As soon," whispered the bad spirit to him, "as I shall have reached the city, I will eat and drink of the best of everything as much as I please, and then purchase what I want. Afterwards I will mix with the food intended for my companions something which I trust will settle their account; thus becoming sole master of the whole of the treasure, which will make me one of the richest men in this part of the world;" and as he purposed to do, so he did. He carried the poisoned food to his companions, who, on their part, while he had been away, had come to the conclusion of killing him on his return, in order that they might divide the money among themselves, saying, "Let us fall upon him the moment he comes, and afterwards eat what he has brought, and divide the money between us in much larger shares than before." The robber who had been into the city now returned with the articles he had bought, and was immediately killed. They then began to feast upon the provisions prepared for them, and were seized with violent pains and soon died. In this manner all three fell victims to each other's avarice and cruelty, without obtaining their ill-gotten wealth,—a striking proof of the judgment of Heaven upon crime. The poor hermit thus wisely fled from the gold, which remained without a single claimant.

Among the many strange ideas formerly entertained respecting the origin of the precious metals, none is more curious than the belief that gold could be made by art. This pretended discovery was called ALCHEMY, or the transmutation of metals, and originated, it is said, in Egypt, and was revived by the Arabians about six hundred years after the birth of our Saviour, whence it spread throughout Europe.

The opinions of these alchemists were that all the metals are *compound*, that is, formed of many ingredients; that the baser metals contained the same elements as gold, mixed, indeed, with many impurities, but capable, when these were removed, of assuming all the properties of gold. The substance possessing this wonderful power was called the *philosopher's stone*, and they usually described it as a red powder, having a peculiar smell. This powder was not only supposed to have a transmuting power, but would cure all diseases, and preserve human life to a wonderful age.

It is impossible to tell the nature of the processes by which the alchemists endeavoured to manufacture the philosopher's stone, or the substances they worked upon. Men of great talents devoted their lives to the investigation of this prodigy, and vast sums of money were consumed in fruitless endeavours to discover it. In some cases it was pretended that gold had been made. About the year 1650 an unknown Italian came to Geneva, and took lodgings at the sign of the "Green Cross." After remaining there a day or two, he requested De Luc, the landlord, to procure him a man acquainted with Italian, to accompany him through the town, and point out those things which were worth seeing. De Luc was acquainted with a Monsieur Gros, at that time about twenty years of age, and a student at Geneva; and knowing his proficiency in the Italian language, requested him to accompany the stranger. To this proposition he willingly acceded, and attended the Italian everywhere for about a fortnight. The stranger now began to complain of want of money, which alarmed M. Gros not a little—for at that time he was very poor,—and he became apprehensive that the stranger might wish to borrow money of him. But instead of this, the Italian asked him if he was acquainted with a goldsmith, whose bellows and other utensils they might be permitted to use, and who would not refuse to supply them with the different articles requisite for a particular process which he wanted to perform. M. Gros named a M. Bureau, to whom they immediately repaired. He readily furnished crucibles, pure tin, quicksilver, and the other things required by the Italian. The goldsmith lent also his own workshop, and one of his own men as an attendant. The Italian put a quantity of tin into one crucible, and a quantity of quicksilver into another. The tin was melted in the fire, and the quicksilver heated. It was then poured into the melted tin, and at the same time a red powder enclosed in wax was thrown into the mixture. An agitation took place, and a great deal of smoke was exhaled from the crucible; but this soon subsided, and the whole being poured out, formed six heavy ingots or masses, having the colour of gold. The goldsmith was called in by the Italian, and requested to make a rigid examination of the smallest of these ingots, which he did, and declared that he had never seen gold so perfectly pure. The Italian presented him with the smallest ingot as a recompence, and then, accompanied by M. Gros, he repaired to the mint, where he received a quantity of Spanish gold coin equal in weight to the ingots he had brought. To M. Gros he made a present of twenty pieces, for the attention he had paid to him; and after paying his bill at the inn, he added fifteen pieces more to entertain M. Gros and the goldsmith for some days, and in the meantime he ordered a supper, that he might, on his return, have the pleasure of supping with them. He went away, but never returned.

Another story is told, on the authority of an English bishop, who communicated it to Mangetus in the year 1685, and at the same time gave him about half an ounce of the gold which an alchemist had made. A stranger, meanly dressed, went to Mr. Boyle, and after conversing some time about chemical processes, requested to be furnished with some antimony (a brittle metal, easily reduced to powder), and some other common metallic substances, which then fortunately happened to be in Mr. Boyle's house. These were put into a crucible, or melting-pot, which was then placed in a furnace. As soon as these metals were fused, the stranger showed a powder to the attendants, which he threw into the crucible, and instantly went out, directing the servants to allow the crucible to remain in the furnace until the fire went out of its own accord, and promising, at the same time, to return in a few hours. But as he never fulfilled this promise, Boyle ordered the cover to be taken off the crucible, and found that it contained a yellow-coloured metal, possessing all the properties of pure gold, and only a little lighter than the weight of the materials put into the crucible.

The following strange account is related by Helvetius, physician to a Prince of Orange. In 1666 a stranger called upon him, and after talking for some time about a medicine that was considered a cure for all evils under the sun, showed a yellow powder, which he declared to be the philosopher's stone, and, at the same time, five large plates of gold which had been made by means of it. Helvetius earnestly entreated that he would give him a little of this powder, or, at least, that he would make a trial of its power; but the stranger refused, promising to return in six weeks. He returned accordingly, and after much entreaty gave Helvetius a piece of the powdered cake or stone, not larger than the size of a rape-seed. When Helvetius expressed his doubt whether so small a portion would be sufficient to change four grains of lead into gold, the stranger broke off one half of it, and assured him that what remained was more than sufficient for the purpose. Helvetius, during the first interview, had concealed a little of the powder below his nail. This he threw into melted lead, but it was almost all driven off in smoke, leaving only a glazy kind of earth. When he mentioned this circumstance the stranger informed him that the powder must be enclosed in wax before it was thrown into the melted lead, lest it should be injured by the smoke of the lead. The stranger promised to return the next day, but having failed to make his appearance, Helvetius, in the presence of his wife and son, put six drams of lead into a crucible, and as soon as it was melted, he threw into it the fragment of philosopher's stone, previously covered over with wax. The crucible was now covered, and left for a quarter of an hour in the fire, at the end of which time he found the whole lead converted into gold. The colour was at first a deep green; being poured into another vessel it assumed a blood-red colour; but when cold it acquired the true tint of gold, and on close examination proved to be the precious metal.

These, and many similar stories, are related of the philosopher's stone, but it is easy to perceive that they are exaggerations or misstatements. A little vanity might easily induce the narrators to suppress or alter some particulars, which, if known, would have stripped the statements of everything marvellous which they contain, and let us into the secret of the origin of the gold which these alchemists boasted that they had made.

These stories are, in reality, very absurd; but in olden times the believers in them were almost universal. Impostors went about pretending that they were in possession of the philosopher's stone, and offered to communicate the secret for a suitable reward. This alone ought to have been sufficient to prove the imposture, for those who could make gold were scarcely likely to resort to this trade. Yet, strange as it may appear, they met with abundance of people who supplied them with money to perform their processes. The object of these impostors was either to pocket the money, or make use of it to purchase various substances, from which they extracted oils, acids, or similar products, which they were able to sell at a profit. To keep the persons duped in good spirits, they showed them occasionally small quantities of the baser metals, which they pretended had been converted into gold. I will tell you one or two tricks of this kind which they practised:—Sometimes they used a melting-pot with a false bottom; at the real bottom they placed a quantity of oxide of gold or silver; this was covered with a portion of powdered crucible, fastened together by a little gum-water or wax; the materials being put into this crucible, and heat applied, the false bottom disappeared, the oxide of gold or silver was reduced, and at the end of the process would be found at the bottom of the crucible, and exhibited as the effect of the philosopher's stone.

They had another plan, of making a hole in a piece of charcoal, and filling it with oxide of gold or silver; the opening was then stopped up with a little wax; or they stirred the mixtures in the crucible with hollow rods, containing oxide of gold or silver, and the bottom closed with wax. By these means the gold or silver required was introduced during the process, and shown as the result of alchemic art.

We may smile at these follies, but we must remember that in this, as in most concerns of life, good often springs out of evil. Although the alchemists could not succeed in making gold, or obtain the means of prolonging life, yet as they were constantly engaged in mixing metals, salts, &c., in various ways with each other, their labours, in other respects, were by no means useless, for they invented many a valuable process, and discovered new substances, with which science was enriched.

I have met with some striking verses, entitled "Moral Alchemy," by a clever writer (Horace Smith). I think you will appreciate with me the faithful description given in this poem of the *true* philosopher's stone :—

"The toils of alchemists, whose vain pursuit
Sought to transmute
Dross into gold—their secrets and their store
Of mystic lore,
What to the jibing modern do they seem?
An ignis fatuus chase, a phantasy, a dream!

"Yet for enlightened *moral* alchemists
There still exists
A philosophic stone, whose magic spell
No tongue may tell,
Which renovates the soul's decaying health,
And what it touches turns to purest mental wealth.

"This secret is revealed in every trace
Of Nature's face,
Whose seeming frown invariably tends
To smiling ends,
Transmuting ills into their opposite,
And all that shocks the sense to subsequent delight.

"Seems earth unlovely in her robe of snow?
Then look below,
Where Nature in her subterranean ark,
Silent and dark,
Already has each floral germ unfurled,
That shall revive, and clothe the dead and naked world.

"Behold those perished flowers to earth consigned,
They, like mankind,
Seek in their grave new birth. By Nature's power
Each in its hour
Clothed in new beauty from its tomb shall spring,
And from its tube and chalice heavenward incense fling.

"Laboratories of a wider fold
        I now behold,
Where are prepared the harvests yet unborn,
        Of wine, oil, corn,—
In those mute rayless banquet halls I see
Myriads of coming feasts with all their revelry.

"Yon teeming and minuter cells enclose
        The embryos
Of fruits and seeds, food of the feathered race,
        Whose chanted grace,
Swelling in choral gratitude on high,
Shall with thanksgiving anthems melodize the sky!

"And what materials, mystic alchemist,
        Dost thou enlist
To fabricate this ever-varied feast,
        For man, bird, beast?
Whence the life, plenty, music, beauty, bloom?
From silence, languor, death, unsightliness, and gloom!

"From Nature's magic hand, whose touch makes sadness
        Eventual gladness,
The reverent moral alchemist may learn
        The art to turn
Fate's roughest, hardest, most forbidding dross
Into the mental gold that knows not change nor loss.

"Lose we a valued friend? To soothe our woe
        Let us bestow
On those who still survive an added love,
        So shall we prove,
Howe'er the dear departed we deplore,
In friendship's sum and substance no diminished store.

"Lose we our health? Now may we fully know
        What thanks we owe
For our sane years, perchance of lengthened scope;
        Now does our hope
Point to the day when sickness taking flight,
Shall make us better feel health's exquisite delight.

"In losing fortune, many a lucky elf
Has found himself,—
As all our moral bitters are designed
To brace the mind,
And renovate its healthy tone, the wise
Their sorest trials hail as blessings in disguise.

"There is no gloom on earth, for God above
Chastens in love;
Transmuting sorrows into golden joy
Free from alloy,
His dearest attribute is still to bless,
And man's most welcome hymn is grateful cheerfulness.

CHAPTER II.

WHERE THE PRECIOUS METALS ARE FOUND.

GOLD is now found in all quarters of the world, and, with the exception of iron, there is perhaps no other metal so widely diffused throughout nature. It is much more common in what are termed *alluvial* grounds—that is, deposits left by the action of rivers, floods, and torrents—than among the rocks. It is discovered in the form of spangles in the sands and mud, at the season of low water, and after storms and temporary floods. When gold is found in rocks, it is generally mixed in a greater or less degree with other metals, and usually with silver, copper, and iron. In the Ural district of Russia it is found in small fragments, embedded in coarse gravel. It has been supposed that the gold found in the beds of rivers, has been torn out by the action of the waters from the veins in rocks, but as this precious metal in its native state is, as I have observed, mixed with other matters, you may wonder how the gold only is found, separated from the other ores. The reason is that the latter are liable to decomposition by exposure to air and moisture, and therefore, although they might have been originally in fragments, like the other materials of the rocks that were broken up, they would gradually disappear by decomposition; while gold, from its indestructible nature, remains unchanged except in form. In the same way stream tin has been preserved, because the oxides or rust of tin is not affected by air and moisture,—that is, does not wear away. Gold may be exposed for ages to the atmosphere without undergoing any alteration. A quantity of this metal has been kept for half a year in a melted state in a glasshouse furnace without any change in its value.

Previously to the great discovery of gold in California in 1847, Europe was, to a great extent, supplied with gold from Mexico, Brazil, New Granada, Chili, and Peru. A large quantity was also obtained from the Russian territories in Asia, and the islands of the Indian Archipelago. Africa furnished a less, but still considerable quantity. Our old coin, the *Guinea*, which was first introduced in the reign of Charles the Second, was thus called, because it was made from gold brought from that part of the African coast.

All these countries still produce gold, but the amount they yield, including what is obtained from Europe, is only one-fourth of that obtained from California and Australia.

The gold of Mexico is in a great measure contained in the silver veins of the rocks, which are numerous in that country. The principal silver vein in the rich gold mine of Villalpardo, near Guanaxuato, is traversed by a great number of small earthy veins so rich in gold, although the metal is not visible, that, in order to prevent fraud, the miners are made to bathe in a large tub when they come out of the mine. Stream gold is also found in many of the river deposits in Mexico, and masses of five and six pounds in weight have been met with. But all the gold of Mexico is not equal to a twentieth part of the silver it produces. In former times the natives used vessels of gold and silver, and such immense quantities of silver were poured into Europe in the sixteenth century, that the wooden bowls generally used in the houses of our rich ancestors were replaced by others of silver. During the next century, no person above the rank of a peasant drank his wine or beer from other than a silver tankard; so much so, that in 1696 the use of silver plate, spoons excepted, was prohibited in the public-houses of London.

The Mexicans were famous for their gold and silver carvings: they mixed the metals so dexterously that the feathers of a bird, or the scales of a fish, were imitated to perfection. You may desire to know how this could be done, and it is easy of explanation, for gold and silver are so capable of spreading without breaking, that they may be drawn into very fine wire, or beaten out into leaves thin enough to be carried away by the slightest wind. One ounce of gold may be drawn into two hundred and forty miles of wire, and a cubic foot of gold may be extended, under the goldbeater's hammer, into leaves sufficient to cover one hundred thousand square yards of surface. Silver can be drawn out into wire as fine as a hair without breaking; that which is used by astronomers for delicate scientific operations is not more than half as thick as a human hair.

The most famous gold mines in Europe are those of Hungary and Transylvania, which are of great antiquity and richness. In the valuable Ambras collection of antiquities, at Vienna, may be seen some magnificent specimens of gold and silver from the Hungarian mines in the times of the Romans, and earlier.

What is called the Siebenbürgen, in Eastern Hungary, is a district that has, for a long period, produced large quantities of the precious metals; the chief supply of gold, however, is from the mud deposits in the beds of torrents and rivers. The gipsies, and Wallachians of the lower class in that country, are very skilful in washing the soil, making use of a wooden tray covered with woollen cloth to catch the fine particles of gold, to prevent them from being carried away. Another method of gold-washing used to be very common, numerous pits being dug, over which the stream, with its golden gravel, was made to pass. The gold dust and small nuggets, or pieces of gold, were caught in the pits, and the rich deposits thus accumulated were carefully separated.

Before the discovery of America, Spain was to the rest of Europe what her colonies have since become—the source of mineral wealth. The Carthaginians and Romans drew from her large masses of the precious metals. Pliny, the Roman historian, who resided for some years in that country, relates that three provinces alone yielded annually a quantity of gold equal to £60,000 of our money. The Arabs soon found out the sources of this wealth, and traces of their labours are to be met with along the barren ridge of mountains that cover the north of Andalusia. Upwards of five thousand of these excavations have been found in one district alone.

The wealth which Spain derived during the last century from the gold and silver mines of Chili—then her colony, but now one of the republics of South America—filled her coffers for many years. The Spaniards employed the native Indians in forced work at the mines. The wonderful ruby-silver mines of the district of Copiapo, in Chili, have been opened and carried on by English labour and capital. Brazil furnishes a large amount of the gold now brought into the European market, yet there is not in that country any gold mine properly so called, for the veins in the rocks containing the metal are seldom worked. When this country was first discovered, gold was so abundant that the inhabitants made their fish-hooks of that metal, but employed no iron, although the country abounds in it. The gravel and mud are washed, and the gold is separated by a process similar to that followed in the tin stream-works of Cornwall.

Gold has been found in considerable quantities in the mountainous parts of the southern states of North America, especially in North Carolina.

The gold mines of Russia have yielded, for some years past, a revenue of nearly four millions sterling; the working consists in mere stamping and washing. The number of localities in which gold has been found in England is above forty, besides numerous tin streams (that is, where tin is found in alluvial or bed deposits), in which particles of gold are sometimes discovered. In Cornwall the miners collect these minute pieces in quills. It was for this county and Devonshire that most of the grants for gold and silver mines, and the privileges of working them, were make in the Middle Ages, so that the existence of gold in tin streams must have been as well known then as it was to the Romans.

Gold, however, has been rarely found in England in sufficient quantities to repay the expense of working it. There are several gold districts in Wales, and some fine specimens have been produced from them. In Scotland, the lead hills in Dumfriesshire, as well as the Highlands of Perthshire, have at various times produced gold. Tradition commonly attributes the original discovery of the Wicklow gold mines, in Ireland, to a poor schoolmaster, who, while fishing in one of the small streams which descend from the Croghan mountains, picked up a piece of shining metal, and having ascertained that it was gold, he gradually enriched himself by the success of his researches in that and the neighbouring streams; cautiously disposing of the produce of his labour to a goldsmith in Dublin. He is said to have preserved the secret for upwards of twenty years, but marrying a young wife, he imprudently confided his discovery to her, and she, believing her husband to be mad, immediately revealed the circumstance to her relations, through whose means it was made public. This was towards the close of the year 1795, and the effect it produced was remarkable. Thousands of every age and sex hurried to the spot—from the labourer who could wield a spade or pickaxe to the child who scraped the rock with a rusty nail; all were eagerly employed in the search after gold. The Irish are a people possessed of a rich and quick fancy, and the very name of a gold mine carried with it, to the ignorant mind ideas of inexhaustible wealth.

During the interval which elapsed between the publicity of the gold discovery, and the Government taking possession of the mine—a period of about two months—it is supposed that upwards of two thousand five hundred ounces of gold were collected by the peasants, principally from the mud and sand of Ballinvally stream, and disposed of for about ten thousand pounds, a sum far exceeding the produce of the mine during the Government operations, which amounted to little more than three thousand five hundred pounds. The gold was found in pieces of all forms and sizes, from the smallest perceptible particle to the extraordinary mass of twenty-two ounces, which sold for eighty guineas. This large piece was of an irregular form; it measured four inches in its greatest length, and three in breadth; and in thickness it varied from half an inch to an inch; a gilt cast of it may be seen in the museum of Trinity College, Dublin. So pure was the gold generally found, that it was the custom of the Dublin goldsmiths to put gold coin in the opposite scale to it, and give weight for weight.

The Government works were carried on until 1798, when all the machinery was destroyed in the insurrection. The mining was renewed in 1801, but not being found sufficiently productive to pay the expenses, the search was abandoned. There prevails yet, however, a lingering belief among the peasants that there is still gold in Kinsella, and only the "lucky man" is wanting. It is to this mine that Moore alludes in one of his beautiful poems :—

> "Where sparkles of golden splendour
> All over the surface shine;
> But if in pursuit we go deeper,
> Allured by the gleam that shone,
> Ah! false is the dream of the sleeper,
> Like love, the bright ore is gone!"

Although the supply of gold from the various sources I have mentioned was, previously to 1848, very large, Russia alone producing an enormous quantity, still gold was comparatively rare, and some people began to have serious apprehensions about a future deficiency of the precious metal. It was therefore with feelings of wonder and satisfaction that the gold discoveries in *California* in 1848, and afterwards in *Australia*, *New Zealand*, *Nova Scotia*, and *British Columbia*, were received by the world generally.

I will briefly describe the region which first led the way to these golden results. The name of California was first applied to a peninsula on the west side of Mexico, in South America, but was gradually extended to a large portion of the adjoining continent. The original California, however, and its addition, were distinguished from each other as Old and New, Lower and Upper. In 1848, partly by conquest and partly by purchase, the Government of the United States became possessed of the continent. After existing as a *territory* for two years, it was in 1850 subdivided, one portion becoming the *state* of California, and another portion eastward, the Utah, inhabited by that strange sect, the Mormons. Between the two Californias of the present day, the American and the Mexican, there is nothing in common but the name. Mexican California is the peninsula I have mentioned, which, although considerably longer than Great Britain, is yet so narrow as to be very little larger than Scotland. The population does not exceed ten thousand. From end to end of the country is one ridge of mountains, which sometimes rise to about five thousand feet above the sea.

American California attracted but little attention until the rumours of gold discoveries changed, as if by a miracle, the aspect of affairs. The harbour of San Francisco, one of the finest to be seen, became the grand centre of attraction to gold-seekers from all parts of the world. Between 1850 and 1852 the population increased from 92,597 to 264,435, and in 1855 the number of inhabitants was 327,000. In 1852 the quantity of gold sent from these gold regions amounted to upwards of nine millions of pounds sterling; and between April, 1849, and December, 1856, the gold exported averaged forty millions and a quarter of pounds sterling yearly.

The discovery of this gold occurred in a singular manner. In September, 1847, Captain Suter, or Sutter, a Swiss by birth, and a settler in this part of California, contracted with a Mr. Marshall for the construction of a saw-mill in a pine forest. The supply of water to this mill was so situated as to wash down much mud and gravel from the higher course of the stream, and Mr. Marshall, while watching the progress of his works one day, observed some glittering particles in this mud. He felt satisfied in his own mind of the value of these shining spangles, and having shown some of them to the captain, it was agreed to keep the matter secret for a time. Somehow or other, however, it was reported that gold had been discovered at the American fork of the Sacramento river, and great excitement ensued. A few labourers collected some of the gold dust, and took it for sale to San Francisco, at which town the Sacramento river enters the Pacific Ocean. Hundreds flocked to the spot, Indian labourers were hired, soldiers and sailors deserted from their duty, tradesmen closed their shops and set off, so that San Francisco became almost abandoned.

Stories are told of the manner in which the first discoveries of gold in California were turned to account by some ingenious speculators; among others, we may mention that in one district the gold dust was mixed with large quantities of fine black sand, which the miners—most of whom were raw hands—blew off from the gold in their anxiety to arrive at the ore itself. A keen old man turned their impatience to account by shamming lameness, and pretending that in his weakly state he was not equal to the toil of mining, and was thus compelled to resort to the poor and profitless branch of gathering the black sand, which he sold as a substitute for emery. He used to go about of an evening with a large bag and a tin tray, requesting the miners to blow their black sand upon it, and returning with it to his hut: by the aid of quicksilver he was able to extract the gold, double in quantity to that which was obtained by the hardest working miner at the washings.

Tricks of every kind were played upon new comers in search of the gold treasures. One story is told of some American associates who had been working at an unprofitable spot, putting up a notice that their "valuable site" was for sale, as they were going elsewhere. A few Germans who had just arrived offered themselves as purchasers. The price asked was exorbitant, as the proprietors stated that the "diggings" returned a large amount of gold, and the following day was appointed for the Germans to come and see what could be produced in the course of a few hours' working. The sellers went during the night and secreted the gold dust in the banks, so that it would come to light, as a natural deposit, when the earth was turned up. The following morning the poor Germans were so delighted with the apparent richness of the place, that they gave a large sum of money and two valuable gold watches for the property. The Germans were laughed at, but like true sons of patience they went to work, and actually succeeded in raising a large amount of gold beneath the spot where the others had left off. The Americans were thus outwitted in turn, and endeavoured to get repossession of the place by force, but another company of Germans arriving, they were obliged to decamp.

Kelly, in his "Stroll through the Diggings," relates "that while working on Rock Creek, the weather being very hot, we always had near us a can of water, and close to it we put a teacup to hold the particles of gold as we collected them. One morning as we were at work a thirsty digger came by, who asked permission to take a draught of water, which being granted, he filled up the cup, and quaffed off the costly drink, without either drinking our healths, or leaving the least sediment at the bottom. I suspected at first that some trick had been played upon us, and he had secreted the gold, but from the evident distress of the man, and the earnest manner in which he promised to repay us when he got work, I firmly believe that he had swallowed the gold, not having noticed it in the cup!"

Scarcely twenty years have elapsed since the gold yield in California became an undoubted fact, and within that brief period of time several millions of gold dust have been added to the wealth of the world. But even these extraordinary results have been eclipsed by the wonderful discoveries of gold in Australia. So extensively are the gold deposits distributed throughout that great country, that Melbourne, the capital, has been said to be paved with the rich metal; the broken quartz rocks which have been used to make the streets being found to contain gold.

It was in September, 1851, that news reached England of gold having been found in Australia,—that is, gold in large quantities. Early in May the announcement was made at Sydney by letters from Bathurst, and the effect was electric. As we have before mentioned, gold may occur in quartz veins in pieces of various dimensions; one was found by an aboriginal Australian shepherd that weighed no less than one hundred and six pounds. The particulars of this discovery are related in the Bathurst, New South Wales, *Free Press*, of July 16th, 1851. It appears that the fortunate discoverer was an educated aboriginal, formerly attached to the Wellington Mission, and in the employment of a Dr. Kerr, of Wallawa. This man returned home with the intelligence that he had seen a large mass of gold amongst a heap of quartz, whilst tending his sheep. Gold being the universal topic of conversation at that time (the first discovery of that metal having been made in the month of May preceding), the curiosity of the sable son of the forest had been excited, and being provided with a tomahawk, he had amused himself with exploring the country adjacent to the land belonging to his employer, and had thus made the discovery. His attention was first directed to the spot by observing some specks of a glittering yellow substance upon the surface of the quartz, upon which he applied his tomahawk and broke off a portion. The splendid prize was in a moment revealed to him. He started off to inform his master, to whom he gave over all claims to it. Dr. Kerr was soon on the ground, and three blocks of quartz, containing one hundredweight of gold, were soon released from the bed where they had probably rested some thousands of years. The spot where the treasure was found is celebrated in the annals of gold districts; it is situated about fifty-three miles from Bathurst. We must not forget to add, that in return for the services of the native, Dr. Kerr gave him and his brother two flocks of sheep, two saddle-horses, a quantity of rations, together with some land and a team of bullocks.

The report of this discovery created great excitement, and a mining mania seemed to seize every one. Groups of people were to be seen at every corner of the streets debating upon the subject; persons of all trades, callings, and pursuits set off in search of gold. The blacksmiths of the town could not manufacture the tools required fast enough or in sufficient quantities, and the roads to the diggings were filled with new-made miners from every quarter; some armed with picks, others shouldering crowbars and shovels, and some with wash-hand basins and tin-pots for cleaning and holding the gold; garden and agricultural implements, of every variety, either hung from the saddle-bow or dangled about the persons of the gold-searchers. Now and then a respectable tradesman, who had just left his bench or counter, would appear with a huge load in front of his horse, and which he called a "cradle," for washing the gold. Many would rush from their homes, only provided with a blanket, and some iron bar or tool, to make their way to fortune.

The centre of attraction to these gold-searchers is situated nearly due west of Sydney, separated from the sea-coast by the ridge of the Blue Mountains. Mr. Stutchbury, a geologist employed by the Government, and Mr. Hargraves, were the first to make the golden announcement. Sir Roderick I. Murchison had, however, some time before, expressed an opinion that gold could be found in Australia. Since this period many wonderful discoveries of the precious metal have been made, and, even should this supply fail, the good that would remain from the immense tide of emigration that has set in for that country would more than compensate, by turning the attention of the settlers to agriculture, and the development of the vast resources of Australia.

The gold discoveries in Australia had a powerful influence on the destinies of NEW ZEALAND. At first, we are told, the report was disbelieved, but when ships arrived with accounts of large masses of gold having been found by unskilled hands, fifteen hundred able-bodied settlers and fifty natives left for the gold regions; but many came back, bringing stories of diggers dying for want of food, with their pockets full of gold; that the New Zealanders began to see that if gold was not directly got in their own country, it was indirectly obtained by cultivating the soil, and sending provisions to Australia. Some attempts, however, were made to find the precious metal, and in 1852 it was discovered about forty miles from Auckland, in the bed of a mountain stream. The specimens were sufficiently large to show that metal lay in the ground, and a rush was made to the spot. Gold has since been detected at Nelson, Otago, and other places, in sufficient quantities to convince the most incredulous, that the rocks in New Zealand are gold-bearing rocks.

But more important for New Zealand than the discovery of gold was the finding of *coal* at Nelson, Otago, and Auckland, just when steam communication between the colony and Australia, and between the different provinces, was on the eve of commencing.

Gold has been discovered in NOVA SCOTIA, near

Tangier Harbour, about forty or fifty miles east of Halifax, the capital. The lodes, which are in the quartz rock, extend for a very considerable distance, and are very rich. The gold mines of GUIANA, the El Dorado so fruitlessly sought by the unfortunate Sir Walter Raleigh, were discovered about 1857, by an Indian, while hunting in the woods for stray donkeys. He pulled up a bush and found a large piece of pure gold at the roots. He carried it to a German merchant for sale, and the trader endeavoured to obtain the secret of its discovery from the Indian. He refused to give the required information, and he was made drunk, and then cruelly beaten until the secret was wrung from him.

The discovery of these mines corresponds with the description given by Sir Walter Raleigh of the manner in which the Indians obtained their gold, viz., "And being asked how they got the same gold, they told us they went to a certain down or plain, and pulled and digged up the grass by the root, which done, they took off the earth, putting it into great buckets, which they carried to wash at the river." That these mines were known to the early Spaniards is proved. They are undoubtedly exceedingly rich, and large quantities of gold have recently been discovered. In consequence, however, of the labour required to obtain it, and the deadly nature of the climate, the work is slow.

Many gold discoveries have been made at the same time, at several points, and by several individuals. One of the first miners who drove a pick into the gold-fields of BRITISH COLUMBIA was a Scotchman, of the name of Adams. He was travelling in the Hudson's Bay territory, and while stopping at one of the trading posts he learned from a friend that Indians living near Fraser River had brought some gold-dust, which they offered for sale. This news made him excited, for Adams had been a miner in California, and he resolved to examine the facts for himself. He therefore set out on the track of these Indians, and eventually discovered them in their hut, occupied in washing gold in their baskets. Having himself proceeded to the banks of Fraser River, he perceived that the ground was rich in gold. He hired a couple of Indians, and worked with them for three months. Tired of living apart from the society of white men, and having in these three months collected upwards of one thousand dollars, he left the spot, and at a later date told his story to some American sailors, who accompanied him next year to the scene of action. The rumour of this discovery, however, had been spread in Victoria, the capital of Vancouver's Island, and miners flocked to the place. Since 1858 the gold-fields of British Columbia have yielded considerable quantities of gold, especially at Cariboo, situated along Fraser River and opposite the Rocky Mountains. These last deposits were discovered by a young man named McDonnell. But more important than this is the production of *coal*, of which nearly thirty-three thousand tons were exported in 1865 by a single mining company. Copper, silver, lead, and other ores have also been found in considerable quantities.

In CANADA a gold district has been discovered, about thirty-five miles from Quebec, extending over forty miles. The mines of Chaudière have yielded pieces of gold weighing nearly one ounce of the pure metal, and large lumps have been washed from the banks.

Mr. Jonston, in his history of the "Wonderful Things of Nature," a work written in the seventeenth century, gives a curious account of the swallowing of precious metals by animals; and these are, in a measure, corroborated by recent instances. The late Mr. Irton, member of Parliament for West Cumberland, found a piece of gold in carving a pullet, which was supposed to have been picked up in a rivulet on his estate.

The mules employed in the Mexican mines are, after death, opened, and sometimes as much as seven pounds of silver is found in the stomach. Gold has been found in the coops of ducks in Australia and Brazil. Sir James Campbell, having stopped for a time at Zante, one of the Ionian Islands, noticed a small variety of Barbary pigeons, which, at a certain period of summer, arrive in swarms from the coasts of Africa. Some of these birds having been shot, he noticed that their claws were filled with a glistening sand. He collected this powder on a sheet of paper, and after carefully analyzing it, discovered that it contained a considerable quantity of gold. The probability is that these winged emigrants, upon setting out, settle down to drink on the banks of a stream whose sand is impregnated with gold-dust. But where are these fortunate shores? This is what the pigeon messengers have not been able to tell, and travellers have not yet discovered.

"But scarce observed, the knowing and the bold
Fall in the general massacre of gold;
Wide-wasting pest! that rages unconfined,
And crowds with crimes the records of mankind;
For gold, his sword the hireling ruffian draws;
For gold, the hireling judge distorts the laws;
Wealth heaped on wealth, nor truth nor safety buys,
The dangers gather as the treasures rise."

CHAPTER III.

THE SILVER MINES OF SOUTH AMERICA.

In the preceding pages I have confined my remarks more particularly to the first of the precious metals. I will now give you some information respecting Silver, which ranks next in importance. Gold and silver, however, approached each other nearer in value in early times than at present. An ounce of fine gold was worth from ten to twelve ounces of fine silver, the variation depending upon the accidental relation of the supply of both metals. But after the discovery of America, the quantity of silver found in that continent, particularly in Mexico, was so great compared with gold, that silver became considerably cheaper, so that an ounce of fine gold was equal to about fourteen ounces and a half of fine silver. These values, however, changed a little according to the abundance of silver.

The forms in which silver is found in nature are numerous. *Native* silver occurs occasionally in all the places that yield silver *ore,* as in Mexico and Peru, Saxony, the Hartz Mountains in Germany, Norway, Siberia, Spain, and, in our own country, Cornwall and Devonshire. It appears in various forms, but usually in threads, or tree-like crystals, twining around small rocky fragments. There are some beautiful specimens of these from the Hartz Mountains in the British Museum. One fine piece found at Kongsberg, in Denmark, is now in the Copenhagen Museum, and weighs five hundred pounds. But the quantity of silver found in nature in the metallic state is comparatively small. Its principal ores are the different sulphurets, namely, sulphuret of silver, containing, when pure, eighty-seven parts of silver and thirteen of sulphur; brittle silver ore, or sulphuret of silver and antimony; and red silver ore, called also ruby silver, of which there is a dark and a light kind, the former being similar to brittle silver ore, but a little less rich in silver, and the latter only differing in containing arsenic instead of antimony. A great portion of the silver obtained in Mexico and South America comes from these ores, as also Horn silver, or chloride of silver.

Besides the ores mentioned, much of the silver of commerce is obtained from mixed ores,—that is, the ores of other metals are frequently found to contain it. These are for the most part sulphurets of tin, arsenic, copper, iron, and lead. In Wales a considerable quantity of silver is produced from the lead mines, since the introduction of the "Pattinson" process, for separating silver from lead, and which you will find described in my remarks upon the latter metal. The Gogerddau mines, near Aberystwith, were very productive in silver extracted from lead, about two or three centuries ago, even under the old system. Sir Hugh Myddleton realized a profit from these mines of about twenty-five thousand pounds a year, which enabled him to pursue his great undertaking of bringing the New River from Ware to London. On his death, a Mr. Bushell, remarkable for his loyalty to King Charles the First, purchased these mines, and having obtained the privilege of coining money, he established forges, and clothed the king's army with a part of the silver which he extracted from his mines and coined himself.

There are many indications at the present time to show that the progress of mining adventure is likely to be as rapid with regard to silver as gold. During the late American contest the accounts from California have attracted less attention than usual; but it is known that the production of silver in that State is steadily increasing. It has also been ascertained that an extensive silver-yielding region exists in the Argentine Republic, in the province of San Juan, at the foot of the Andes, about seven hundred miles from Buenos Ayres, the production of which is likely to become as rich as any field heretofore worked. The silver deposits extend over a space of one hundred miles. At a place called St. Arnaud, in the colony of Victoria, a company are working some silver lodes of great richness. Some extraordinary discoveries of silver, in immense quantities, have been made in California. Silver Peak, situated east of St. Francisco, is described as the depository of the precious metal, and the locality is abundant in mineral riches.

The wonderful accounts that have been related of the abundance of silver in MEXICO and PERU would appear almost fabulous, but for their confirmation by travellers of the highest reputation. The celebrated Humboldt informs us that, in the space of three hundred years, the mines in the countries we have mentioned furnished three hundred and sixteen million twenty-three thousand eight hundred and eighty-three pounds weight of pure silver, which would form a solid globe of that metal upwards of ninety-one feet in diameter. It is estimated that the annual produce of silver from the Mexican mines is now about one million six hundred thousand pounds weight.

That which distinguishes the mines of Mexico from those of Peru, and from the greater part of the other mines in America that possess silver veins, is the character of the situation in which they are found. The greater portion of the Mexican mines are in regions favourable foi working them. They are seldom situated at more than from 6,500 to 7,150 feet above the level of the sea. The famous silver mines of Valenciana and Rayas, near Guanaxuato, which, at the commencement of the present century, yielded more silver than Potosi, are in a charming climate, and within reach of a district that yields abundantly whatever is needed for the comfortable subsistence of the miners, as well as fodder for the mules, which are employed in great numbers on the works. The mines of Peru, on the contrary, are in cold regions bordering on snow. Thus the Pasco mountains, from which an enormous amount of silver is obtained, are more than 13,000 feet high. Another mine, the Gualgayoc, is 13,260 feet in height. The celebrated mine of Potosi has been worked to an altitude as great as the summit of Mont Blanc.

The silver mines of Pasco, in Peru, were discovered about two hundred and fifty years ago, by an Indian shepherd named Huari Capcha. While watching his flock he lay down to rest himself on the side of a hill, and the weather being cold, he lit a fire. On the following morning he was surprised to find the stone beneath the ashes of his fire covered with silver. The shepherd lost no time in informing his master of this discovery, and the result was that a very rich vein of silver ore was found, and preparations made at once for working it. In this mine, which is called the "Discovery," silver is still obtained. From the village of Pasco, about six miles distant, arrived several rich mine-owners, large works were erected, and at length a city was founded, which now contains a population of nearly twenty thousand.

Indians are employed in working these mines, and some of them are very cunning in concealing pieces of silver ore on their persons. Although narrowly watched by overseers, they sometimes contrive to carry off large pieces. A very valuable mass was thus taken by a miner, who, pretending illness, fastened it on his back, and covering himself in his cloak, obtained permission to quit the mine. What is called the *polvorilla*, a dark powdery kind of ore, very full of silver, used to be abstracted from the mines by the following trick. The workmen would strip off their clothes, and having moistened the whole of their bodies with water, they would roll themselves in the polvorilla, which stuck to their skin. On their return home they would wash off the silver dust, and then sell it. This trick was, however, at length found out, and a stop was put to it, as the labourers before leaving the mine were required to strip in order to be searched.

These Indian miners work with a patient industry which European labourers cannot equal. Content with insufficient and wretched food, the Indian goes through his hard day's work, with no refreshment but cocoa, and at the end of the week is satisfied with a payment equal to four or five shillings in our money.

Among the richest silver mining districts in Peru are the provinces of Pataz, *Huamanchucho*, *Caxamarca*, and *Hualgayoc*. In this last-named country are situated the mines of San Fernando, which have been celebrated by Alexander Von Humboldt. The chains of hills in the southern districts of Peru contain a multitude of very rich mines. The *Salcedo* mine is famous for the abundance of silver it contained, and the tragical end of its original owner.

Salcedo was a poor Spaniard, who lived at Pinno, and was attached to a young Indian girl. Her mother promised to show Salcedo a mine which she had discovered, and it proved a source of great wealth to her son-in-law; for he had married the daughter, and by his industry and perseverance had worked the mine into a most thriving condition. The report of his riches excited the envy of the Spanish Governor or Viceroy of Peru, the Count de Lemos, who endeavoured to get possession of the mine. Salcedo, however, by his generosity and benevolence had gained the good-will of the people among whom he lived, and especially the Indian population, and the Viceroy turned this circumstance to the disadvantage of Salcedo, by insinuating to the Spanish Government that the wealthy mine-owner was endeavouring to raise an insurrection among the Indians to throw off the Spanish yoke. Salcedo, on this accusation, was arrested, subjected to a mock trial, and sentenced to death. Whilst in prison he begged permission to send to Madrid the documents relating to his trial, and to appeal to the king for mercy. He offered, if the Viceroy would grant his request, to pay him the daily tribute of a bar of silver from the time that the ship left the port of Callao with the documents, until the day of her return. When it is considered that at the period of this occurrence, in 1669, the voyage from Callao to Spain occupied from twelve to sixteen months, some idea may be formed of the enormous wealth of Salcedo. The Viceroy rejected this offer, ordered Salcedo to be hanged, and set out for Pinno to take possession of the mine.

But this cruel and unjust proceeding failed, and the mercenary governor was defeated in his object. As soon as Salcedo's doom was pronounced, his mother-in-law, accompanied by his relations and friends, repaired to the mine, flooded it with water, destroyed the works, and closed up the entrance so completely that it was impossible to find it out. They then dispersed, but some of them who were afterwards captured could not be induced, either by promises or tortures, to reveal the position of the mine, which remains to this day unknown.

Another instance of the richness of the Peruvian mines is found at *San José*, in the department of *Huancavalica*. The proprietor of this mine requested the Viceroy, whose friend he was, to become godfather to his first child. The Viceroy consented, but at the time fixed for the christening, some important matters prevented him from quitting the capital, and he sent the vice-queen to officiate as his proxy. To render honour to his illustrious guest, the owner of the San José mine caused a triple row of silver bars to be laid down the whole way (and it was no short distance) from his house to the church. Over this silver pavement the vice-queen accompanied the infant to the church, where it was baptized. On returning her generous host presented to her the whole of the silver road, in gratitude for the honour she had conferred upon him.

The Indians are said to be aware of the existence of many rich silver mines in Peru, the situations of which they will not disclose to the whites. In the village of Huancayo there lived, some years ago, two brothers named Yriarte, who were the most prosperous mine-owners in Peru. Having obtained some information that in the neighbouring mountains there were silver veins, they sent a young man in their employment to ascertain the truth. The agent took up his abode in the cottage of a shepherd, and knowing the jealous character of the Indians, he carefully refrained from alluding to the object of his visit. After a short time an attachment arose between the young man and the shepherd's daughter, and at length he confided to her his desire to know where silver could be found. The girl promised to show him the position of a very rich mine. One day, when she was going out in charge of the sheep, she told him to follow at a distance, and to notice the spot where she would let fall, as if by accident, her mantle. On turning up the earth at that place, she assured him he would find the entrance to a mine. The young man followed her directions, and after digging for a little time he discovered a mine of considerable depth, containing rich ore. Whilst busily engaged in breaking out the metal he was joined by the girl's father, who affected to be surprised at the discovery, and offered to assist him. After they had worked for some hours, the Indian offered his companion a cup of drink, which the other had no sooner tasted than he felt convinced that he had been poisoned. He snatched up the bag containing the metal he had collected, mounted his horse, and galloped off with the utmost speed to Huancayo. There he related to his employers all that had occurred, described as accurately as he could the situation of the mine, and died on the following night. Active measures were immediately taken to apprehend the Indian and his family, but without effect, for they had disappeared, and all traces of the mine were lost.

In Huancayo there resided a Franciscan monk, who was much addicted to gambling, a very common vice in these mining districts. He got into great difficulties in money matters. The Indians in the neighbourhood of his dwelling were much attached to him, as he was of a kind and generous disposition, and they frequently sent him presents of poultry, cheese, and butter. One day, after he had been a loser to a considerable amount at the gaming-table, he complained bitterly of his misfortunes to an Indian who was particularly attached to him. After some deliberation the Indian remarked that he might possibly be able to assist him, and on the following evening he brought him a large box full of silver ore. This present was several times repeated, and the monk was curious to find out where the treasure was obtained. He accordingly pressed the Indian so closely, that the latter consented to show him the mine from which the silver was produced, and on an appointed night he came with two of his friends to the house of the monk. They blindfolded him, and each of them, in turn, carried him on their shoulders a distance of several leagues into the mountain passes. At length they set him down, and the bandage being removed from his eyes, he discovered that he was in a small and somewhat shallow shaft, and was surrounded by bright masses of silver. He was allowed to take away as much as he could carry, and when laden with the rich prize, he was again blindfolded, and conveyed back in the same manner as he had been brought to the mine. Whilst the Indians were conducting him home he unfastened his rosary, and dropped the beads at intervals along the path, hoping by this means to find his way back to the mine on the following morning; but in the course of an hour or two after reaching home, his Indian friend knocked at the door, and giving him a handful of beads, said, "You dropped your rosary on the way, father, and I have picked it up." You may be sure after this attempt to cheat his generous friends that the monk got no more silver from them.

When Peru was under the rule of Spain, the Peruvian Indians suffered fearful hardships. Some writers estimate at nine millions the number of poor Indians who died from forced labour in the mines during the course of three centuries.

The silver that is now extracted from the mines in Peru, when melted into bars, is consigned to the care of the mule-drivers, and conveyed to Lima, the capital city. Although robberies are frequent, yet as the bars are stamped with the Government mark, and the punishment inflicted upon those who attempt to steal them is very severe, the rich produce of the mines generally reaches its destination safely. The corruption of morals which distinguish, especially, the mining districts, is a fertile source of crime and misery,—a contrast to those countries depending for their *true* wealth on agriculture.

The veins of silver in Mexico had not, immediately after the conquest of that country by the Spaniards, the reputation of those of Peru. It was a few years after that event, a mine of silver was discovered, so prodigiously rich, that the name is still used to signify unbounded wealth. This wonderful mine is in the mountain called Hatun Potocchi, which name Europeans have changed into *Potosi.* It is a few miles from La Plata, the capital of Upper Peru. These mines, from the time of their first being worked, in 1545, to the beginning of the present century, produced silver to the amount of more than two hundred and thirty-seven millions sterling, including only what had paid the royal duty, but if the gold and smuggled metal were added, the amount would be very much greater. These mines have caused the destruction of thousands of human beings, for at one time sixteen thousand Indians were constantly employed to work in them, under the most severe hardships, many of them perishing from hard and forced labour. At present only about two thousand miners are employed, who work from choice, and are well fed and cared for.

The town is eleven thousand feet above the level ot the sea. It was founded in 1547, and about fifty years afterwards the population is said to have numbered one hundred and sixty thousand souls. Many and strange have been the chances of persons who have been engaged in mining speculations both at home and abroad. Fortunes have been gained and lost in a very short space of time. It would seem as if the search after riches produced but little satisfaction, and more frequently reverses sufficient to deter men from indulging in "golden dreams." Humboldt relates of a Frenchman named Joseph Laborde, that he went to Mexico, very poor, in 1743, and gained a large fortune in a very short time in a mine called La Canada. After building a church at Pasco, which cost him eighty-four thousand pounds, he was reduced to the lowest poverty by the rapid decline of those very mines, from which he had annually drawn upwards of one hundred and ninety thousand pounds weight of silver. With a sum of twenty thousand pounds, raised by selling a sun of solid gold which he placed in the church raised by him, and which he was allowed to withdraw, he undertook to clear out an old mine, in doing which he lost the greater part of the produce of the golden sun, and then abandoned the work. With the small sum remaining he once more ventured upon another undertaking, which was, for a short time, very productive, and he left behind him at his death, a fortune of one hundred and twenty thousand pounds.

It was a Mexican miner, named Bartolomé Medina, who in 1557 discovered the method by which almost the whole of the ore in the South American mines, has been treated to the present day. This is called the *cold amalgam*, and is based upon the employment of mercury, and of some other ingredients much less expensive,—such, for instance, as salt. This allows of the metal being extracted from poor ores without having to melt them, and consequently no combustible matter is needed.

The annual consumption of silver in the United Kingdom has been estimated at about three millions and a quarter ounces, valued at eight hundred and twenty thousand five hundred and eleven pounds sterling. The value of the stock of silver in the hands of the manufacturers and dealers is estimated at three millions two hundred and eighty thousand pounds sterling.

"Mark where yon mines their radiant stores unfold,
Peru's rich dust, or Chili's beds of gold:
What nations bribed have owned thy powerful reign!
For thee what millions ploughed the stormy main,
Travelled from pole to pole, with ceaseless toil,
And felt their blood alternate freeze and boil!"

CHAPTER IV.

A CHAT ABOUT COALS.

It has been well remarked "that there are two words, each containing only four letters, but expressive of the two most valuable minerals in the world,—*coal* and *gold*. No two minerals are more opposite in appearance; the one is bright and dazzling, the other is black and forbidding. One is the miser's delight, the other every man's comfort. One is stored up in banks and bank cellars, the other in coal-fields and coal mines. Gold soils the mind of him who hugs it as a miser; coal soils only the face and hands of him who gets it as a miner. One is the apparent representative of the country's wealth; the other is its real representation."

Now nothing can be more true than this contrast, which points to coal as one of the chief necessities of man. And what a wonderful gift of Providence it is that supplies us with such exhaustless means of comfort and happiness,—the gas that gives such a cheerful light to our homes, the steam-engine that glides so swiftly on the railway or quickens the speed of the ship upon the waters, the numberless manufactories that are carried on, and the inventions that are perfected by the use of coal!

As you sit "round about the coal fire" you can scarcely realize the discomforts of our forefathers ages ago. It is difficult to imagine how they could have borne the nuisance of wood-smoke filling their rooms, until it found its way through the lantern roof. Yet such was the case before chimneys came into use in the reign of Elizabeth.

It is little more than four hundred years ago since Englishmen, except for cooking or for furnaces, appear to have cared but little about warming their houses. Even so late as the reign of Henry the Eighth no fire was allowed in the University of Oxford; and after supper, at eight o'clock, the scholars went to their books for an hour, and afterwards took a run to warm themselves before going to bed. This you would consider a great hardship.

In the city of London, now so brilliantly illuminated by gas, the Lord Mayor, in 1416, ordered lights and lanterns to be hung out of houses during the winter evenings, to throw some light into the dreary streets; and travellers provided themselves with lanterns to find their way about. For three hundred years this practice continued, until the reign of Queen Anne. So badly off was the city in this respect, in the time of Queen Elizabeth, that as silence was necessary in the public thoroughfares, in order that the watchman might *hear*, if he could not *see*, it was directed "that no man should blow any horn in the night, or whistle after nine o'clock in the night, *under pain of imprisonment*."

You may suppose, from what I have mentioned, that coal was unknown in England during these times, but such was not the case. The early Britons, and the Romans who ruled over them, were acquainted with its properties as a fuel. It is supposed, however, that they only made use of it when wood was not to be had near them in sufficient quantity; but there is no reason to believe that any pits were dug in the coal beds, and it was only the small seams on the surface of the ground that were cropped. The Saxons, who succeeded the Romans, made no general use of coal, for peat and timber were in ample abundance for their wants. Coal is scarcely mentioned during the Danish and Norman usurpations. Any trade in this mineral can scarcely have occurred before the year 1239, when Henry the Third gave the people of Newcastle-upon-Tyne the liberty to dig for it. The consumption, however, must have been small, for we are informed that at the coronation of Edward the Second ten shillings' worth of coal was burnt.

You will, no doubt, wonder why coals, if they were so well known formerly, were not in more use; but you will easily understand that while the people of Newcastle found it cheaper to employ this fuel which was so close to them, it was not so elsewhere. London had so many woods and copses around it, that coals, with the slow means of transport, would have been far more expensive. But, added to this, there were other objections. No sooner was coal employed by various manufacturers in the metropolis than an outcry was raised that the smoke contaminated the atmosphere, and rendered it unwholesome for the people. A petition to this effect was presented to Edward the Second, and the use of the offending fuel was forbidden; the furnaces and kilns of any refractory persons were ordered to be destroyed. The ladies also complained that coal-smoke spoilt their complexions, and they would not eat any food cooked at a coal fire.

You will probably think this was very foolish, and so, in fact, it was; but we must make many allowances for popular prejudices, which are found in every age and country, our own not excepted.

Though kings may make laws, necessity can unmake them; and as wood became scarce, so, in spite of restrictions and prejudices, coal came into more frequent use.

It was for a long time called *sea-coal*, because it was imported by sea. About the middle of the sixteenth century, coal had so far advanced in public estimation as to be burnt in kitchens and halls, but wood was still employed in the private rooms, and was long afterwards used in some particular branches of trade, such as smelting iron, glass-making, brewing, dyeing, and chemical operations. Indeed, it was not until timber had become so scarce as to be sold by the pound weight in some districts, that the coal mines came into general requisition.

It is now time that we make the important inquiry, "*What is coal?*" This is a subject that might occupy many pages of great interest, for learned men, both of our own country and others, have made deep researches into its history, but I will endeavour briefly to give an outline of its origin. If you take up a lump of hard coal, and examine it with the naked eye, you will not perceive anything more than a black, pitch-looking substance, without anything in appearance to make it remarkable; but if you observed the same lump through a microscope you would be able to detect the peculiar structure of the *plants* that compose it. Coal is, therefore, a vegetable production, or fossil wood, which has been pressed into the earth during a long lapse of ages into a thick mass. This has passed through the stages of peat or bog, and become gradually hardened into coal. Peat, you know, is also a substance of vegetable origin, found wherever the soil has been soaked with water which has no outlet, and does not completely dry up under the heat of the sun.

By the aid of the microscope it has been ascertained that some beds of coal appear to be wholly composed of very small leaves, for if a mass be extracted from a mine and split asunder, the exposed surfaces are found covered with delicate skins of carbonized (pure charcoal) leaves and fibres matted together, and flake after flake may be peeled through a thickness of many inches, and the same structure be still seen. Rarely are any large trunks and branches observable in the coal, but the appearance is that of an immense deposit of delicate foliage.

Dr. Buckland, in his "Bridgewater Treatise," says of these preserved vegetable remains, "The finest example I have ever witnessed is that of the coal mines of Bohemia. The most elaborate imitations of living foliage upon the painted ceilings of Italian palaces bear no comparison with the beauteous profusion of extinct vegetable forms, with which the galleries of these instructive coal mines are overhung. The roof is covered as with a canopy of gorgeous tapestry, encircled with festoons of most graceful foliage, flung in wild, irregular profusion over every portion of its surface. The effect is heightened by the contrast of the coal-black colour of these vegetables with the light groundwork of the rock to which they are attached. The spectator feels himself transported, as if by enchantment, into the forests of another world; he beholds trees, of forms and character now unknown upon the surface of the earth, presented to his sense almost in the beauty and vigour of their primeval life; their scaly stems and bending branches, with their delicate apparatus of foliage, are all spread forth before him, little impaired by the lapse of countless ages, and bearing faithful records of extinct systems of vegetation, which began and terminated in times of which these relics are the infallible historians."

When you are warming yourself at the fire you can suppose, and with probable truth, that the coal burning before you may be the mineralized remains of some vast forests before the deluge, which were deprived of their watery and vapoury parts, but preserved all their combustible or burning matters, woody fibre containing carbon, hydrogen, and oxygen, with very small quantities of ash and nitrogen. What these are I will now explain. *Carbon* is the basis of common charcoal, or burnt wood, and exists, combined with many other gases, in all vegetable and animal substances. I may also add that its greatest property, when in a pure state, is that it is capable of crystallization, or being rendered bright and transparent, though not by art, and forms that most beautiful and precious of all minerals, the *diamond*, which, although the hardest substance known, can be consumed by fire. *Hydrogen* is a colourless gas, without smell, the basis of what was formerly called inflammable air. This gas is continually proceeding from vegetable and animal matters during their decay, and is a certain consequence of their putrefaction. You may have seen, or no doubt have heard of, that curious flame which dances in the air, called the *ignis fatuus*, or "Will-o'-the-wisp," a light that has frightened many superstitious people in former times, and even in our own days it is regarded with a kind of terror by persons in the country. This light originates from decayed vegetables, and is caused by the mixing of hydrogen gas with carbon, and occasionally with phosphorus (a chemical substance which, exposed to the air, takes fire) and sulphur, or brimstone. *Oxygen*, also a colourless and tasteless gas, is the basis of the air we breathe, and is the chief support of light and heat, and performs an important part in most of the changes that take place in the mineral, vegetable, and animal kingdoms. It has the power of supporting combustion, or burning, in an eminent degree. *Nitrogen* gas is inflammable, and a little lighter than the air we breathe, and forms a part of all animal substances. Indeed, there is scarcely a single process, either natural or artificial, in which this gas has not a share. Nitrogen produces nitre, which you know is used in making saltpetre. You will understand the value of nitrogen when I tell you of the power it has in modifying the inflammable properties of oxygen gas, for if nitrogen were not present in the air, candles and fires would burn fiercely and rapidly, every steady burning would become a swift conflagration, and animal respiration would become so hurried that death would ensue from intense excitement of the nervous system. I will also inform you how necessary to the human body is the combination of the three gases I have mentioned. A man in breathing consumes nearly six hundred and forty pints of oxygen gas from the atmosphere in which he lives during twelve hours, making fourteen thousand four hundred inspirations, and during the short time which elapses between an inspiration, or drawing in of the air, and respiration, or breathing it out, the air is totally changed in its characters; by some mysterious power of Providence the oxygen is abstracted, and united with the carbon, which is one of the elements of the body.

Now that you know the inflammable character of the gases in coal, and which are very closely allied in their nature to the gas employed in lighting our streets and buildings, you will understand what it is that renders the work of the miner so dangerous, creating what is called *fire-damp*. These gases frequently rush forth from cavities in the earth, and, mingling with the air of a mine, explode with terrific violence upon the approach of a candle, often occasioning a great loss of life. These gases are produced most abundantly from the deepest mines, and this has been accounted for by the uniting of the coal in a solid mass having been effected under a great pressure.

From what you have read you will now understand that pressure, heat, and time have been among the chief agents in the formation of coal, and that wood and coal have the greatest connection with each other, the principal matters of both being carbon and hydrogen, though the proportions of these are different in the several kinds of coal.

There are a great many descriptions of coal, though the larger proportion come from Newcastle. It is always found in masses in the northern coal-field, giving direct employment to upwards of sixty thousand persons. In order that you may have some idea of the immense quantities of coal and its consumption, I may mention that Great Britain produces about sixty-five million tons of coal every year; and it is calculated that the coal-fields of England and Wales would supply *sixty* million tons annually for a thousand years to come!

When we consider the enormous lapse of ages during which coal, such an inestimable gift to man, has been preparing, and that the transformation of vegetable remains into this mineral is still going on, in a greater or less degree, in most parts of the world, so that coal may be almost said to be inexhaustible, we are lost in astonishment at the power and benevolence of the omnipotent Creator, and are led to exclaim,—

> "Great are Thy works, Jehovah, infinite
> Thy power! what thoughts can measure Thee, or tongue
> Relate Thee?"

CHAPTER V.

A GLANCE AT A COAL MINE.

WHAT you have read in the preceding chapter will prepare you for an insight into the interior of a COAL MINE. This I will endeavour to explain. I have already mentioned how the miners in search of metals burrow underground like busy moles, and it is the same with collieries in this respect. You know how the sagacious mole works its way into the earth, throwing up the small hills which you may often see in fields and gardens. The little animal may well be called a miner, for he understands well the purpose of his labours, and shows besides a regard for self-preservation, and a foresight, in which its human prototype sometimes fails. When I have described the habitation of a mole, you will form an idea of the operations which are performed in mines. The underground dwelling of the mole contains two circular galleries, one above the other, with five connecting passages, and a central chamber which has access to the upper gallery by three passages, whilst about nine passages lead away from the lower gallery in different directions. The end of a passage entering a gallery on one side is never opposite to the end of a passage entering on the other. And now comes the clever contrivance of this ingenious little miner, when its safety is in peril from mole-catchers, farmers, and gardeners: to afford all facility of escape in case of any alarm, a passage leads at first downwards from the central chamber, and then upwards again till it joins one of the high roads which the mole always keeps open. These are formed by pressing the earth until it becomes smooth and firm, and are not marked by any mole-hills thrown up. These not only serve for escape when necessary, but lead to those of the animal's working grounds where the ordinary mining for worms, its principal food, is carried on.

The contrast in the field of operations between a *mole* and a *human miner* is droll enough; but the latter has also to work his way through sunless galleries, the walls and roofs of which are dark and gloomy, and anything but inviting in appearance for a stranger to visit. Yet the works in mines of great depth are full of interest, and sometimes of excitement, especially after the shaft has been made, the coal beds are reached, and the working out of the mineral commences.

It is very likely you have never heard of a *ball* being given on an occasion like this in a coal mine. Such an event, however, took place in the Gosforth Colliery, near Newcastle, when the first coal was reached in 1829. The scene is thus described. The ball-room was situated at a depth of nearly *one thousand one hundred feet* below the surface of the earth, and was in the shape of the letter L, the width being fifteen feet, the floor twenty-two feet, and the height forty-eight feet. Seats were placed on the sides of the ball-room, the floor was dried and flagged, and the whole place was brilliantly lighted with lamps and candles. The company (about two hundred and fifty in number, and one-half of whom were females) began to assemble and descend the shaft, in appropriate dresses, about half-past nine in the morning, and continued to arrive till one in the afternoon. The men engaged in the works, their wives and daughters, several neighbours with their wives, the proprietors of the mine with their ladies, and friends of both sexes who had the courage to make the descent—all these gradually found their way to the bottom of the shaft. Immediately on their arrival, each person broke off a piece of coal to keep in memory of the event, and then returned to the ball-room. Dancing commenced and continued until three o'clock in the afternoon. No distinction was made among the guests, the gentlemen and ladies joining in the dance with the miners and their families. A band of musicians, composed of miners, enlivened the scene, and refreshments were liberally supplied. All returned in safety to the surface, delighted with their entertainment.

In any public rejoicings or festivals, coal miners are always ready to enjoy a share of the popular enjoyments; and a great relaxation it must be to the poor fellows who work so hard and under such discomforting circumstances.

At the Queen's visit lately to Wolverhampton, at the unveiling of the statue erected to the memory of Prince Albert, the colliers in the Earl of Dudley's mines erected an immense arch of coal, under which the Queen passed. Some of the blocks for this purpose weighed upwards of *three tons*. The arch was ornamented very tastefully with the tools that are used by the miners in their work.

We will now imagine ourselves arrived at the bottom of one of the *Newcastle coal-pits*, a journey sufficiently long to make us feel uncomfortable; for the depth of some mines is very great, that of Dunkinfield Colliery, Cheshire, for instance, being two thousand and fifty-five feet, and Monkwearmouth pit, belonging to the Durham Collieries, being nearly two thousand feet. Arrived at the bottom, we shall find that every trace of daylight is shut out, and it will be some moments before we get accustomed to the lights that are carried by the miners. We then see long galleries or passages branching out in every direction, and men working in them, stooping, lying on their backs, and in every position which will enable them to reach the coal. Here the miner pursues,—

> " Howe'er the daylight smiles or night-storms rave,
> His dangerous labour, deeper than the grave.
> Alike to him whose taper's flickering ray
> Creates a dubious, subterranean day,
> Or whether climbs the sun his noontide track,
> Or starless midnight reigns in coif of black ;
> Intrepid still, though buried at his work,
> Where ambush'd death and hidden dangers lurk ! "

Boys and horses are taking the coal to the mouth of the pit, and some of the horses are born and pass the whole of their lives there without ever seeing daylight.

These galleries are sometimes very extensive ; those in the Killingworth mine, near Newcastle, measure altogether upwards of one hundred and sixty miles. Just imagine what toil and labour such excavations must have cost. More extraordinary still is the Howgill coal-pit, near Whitehaven, where the mining has been carried on more than a thousand yards *under the sea*, and about six hundred feet below the bottom, thus robbing the sea of its treasures. At one colliery, near Newcastle, the passages altogether measure more than twenty miles, and at St. Hilda Colliery, South Shields, the workings underground equal fully seventy miles in gallery extent.

These galleries, or passages, require supports to keep the roof from falling in, and these are called *pillars*, being huge blocks of coal. There are several methods of excavating in coal mines. One is by working the coal into rooms, supported by pillars, which bear just such proportion of size to the coal dug out as is sufficient to bear the roof. Another mode is similar, but the pillars are left larger, with the intention of reducing them when the other works are finished in the mines. In some collieries, narrow rooms or openings are made, so that a large proportion of coal is left, with the view of working back towards the pits, and then removing every pillar if it is safe to do so. Working by what is called the *long-wall* is taking all the coal away as the miners proceed, leaving no pillars; but this method is only adopted with thin coal.

Passages lead between and around the pillars, and iron-tramways or railways are laid along the passages for conveying the tubs of coal from the workings to the shaft. Formerly, the coal was carried on the backs of labourers to the surface of the pit in bags or baskets. This was cruel work, and it is wonderful that men could endure it; but worse than this, women, and children under twelve years of age, underwent the same hardships. The women who carried full loads of coal provided themselves with baskets which were fitted to the back, and were kept steady by a strap around the forehead; the boys and girls carried blocks of coal as heavy as they could lift, and these poor children considered themselves fortunate when they were sufficiently strong to carry a basket and get an increase to their wages. The payment to a regular coal-bearer was one shilling each day, and the ordinary load of coals in each basket was from two hundred to two hundred and forty pounds weight. These had to be carried, not only along the roads in the interior of the mine, but also, in some cases, up to the surface of the pit, by means of winding stairs up the shaft.

It was very shocking to subject women, and young children especially, to this distressing work; and in 1843 an Act of Parliament was passed to prevent the employment of females in mines, and boys under twelve years of age. You would see in a coal mine boys who are still occupied in hard work certainly, but nothing like what it used to be twenty years ago. They seem cheerful in their dark quarters, and get accustomed to their work. Next to the *hewer* (as the man who cuts or digs the coal is called) are the *putters*, youths employed to convey the coals from the workings to the horse-way, the distance being generally about one hundred and fifty yards. When a boy drags or *puts* a load by himself, he is called a *train*, the real meaning of the word being the truck, or carriage, that conveys the tubs of coal. When two boys of unequal size and strength assist each other, the elder is called a *headsman*, or putter, and the younger a *foal*, or boy occupied in "putting" coals, and these lads are paid in proportion to their work. When two boys of about equal age and strength help each other, they are called, in the language of the Newcastle miners, *half-marrows*, or partners, who share alike their earnings. The weight of coal dragged by these various classes of boys, varies from five to ten hundredweight in each basket. The distance they have to walk to and fro in the mine during a day, varies from seven to nine miles. You see what a great amount of fatigue and labour these boys can support as they get accustomed to their labours. The baskets are taken from the workings, where the miner has been digging, to a crane, a machine for lifting them into a truck, called the *rolley*, led by a horse on the tram-way to the bottom of the shaft. A man stands here to hook, or unhook, the empty baskets or tubs which have been let down from the surface, or are about to be drawn up, loaded with coal, to the top.

What a busy hive is the mine, with its hundreds of workpeople, all having their separate employments! Besides those I have mentioned there are the *furnace-men*, who attend to the furnace for ventilating the mine; the *horse-keepers*, who have charge of the horses; the *lamp-keepers*, who take care of the Davy safety-lights; the *waste-men* who walk along all the *wastes*, or deserted workings, to clear away stones and rubbish that may have fallen in, and to see that the air-courses are in good order; the *switch-keepers*, who attend to the *switches*, or passing-places, in the subterranean railways. The *trappers* are little boys who are stationed at traps, or doors, in various parts of the mine, to open them when the baskets have to be passed through, but to keep them closed at other times, in order that the current of air for ventilation may pass through certain passages.

I have already explained to you how necessary *ventilation* is to the preservation of life in mines, and how everything depends upon it. To form some idea of the amount of air required in a moderately sized mine, you may imagine a covering to be placed over a town, Newcastle, for instance, perfectly air-tight; that in every main street, in every cross-street, in all the courts, alleys, lanes, and passages, a current of air should be continually passing along, at the rate of five feet or upwards each second (such as nearly to blow out a small candle), and you will have some idea of the ventilation required.

The *way-cleaners*, as the name denotes, have to keep the rails clear of coal-dust and rubbish; the *wood* and *water-men* carry wood to the miners for props, and remove water from the horse-ways and the other parts of the pit. The managers who superintend the mine are, of course, very intelligent men; the principal of them is the *viewer*, or superintendent, who arranges the whole plan of working the mine, and has for an assistant an *under-viewer*, who is expected to visit the mine every day, to correct any irregularities, and remove any discoverable sources of danger. The *over-man*, or underground overseer, has the charge of the miners, and his chief duty is to go into the pit every morning, one hour before the miners arrive, to see that all is safe; the *deputy over-man* lays the rails of the tram-ways, and secures the workings with timber. The *keeker* is also an overlooker of the coal-diggers.

Besides those I have mentioned there are persons connected with a mine who are employed above ground; the *banks-men*, who land coals at the top of the pit; the *brakes-men*, in charge of the winding engine, which draws the coal up the shaft; the *waiters-on*, who attend at the top of the pit to render any assistance; *trimmers*, men who spread the coals in the ship's hold; *staith-men*, or over-lookers of the shipping of the coals; *screeners*, who empty the coals from the *screens* or boxes into the waggons; and several other workmen, who have various occupations.

Where several hundred men are employed in a mine, it is important that each man should know his particular duty, and thus all confusion is avoided.

The pit dress of the coal-digger is made entirely of coarse flannel, and consists of a long jacket, with large side pockets, a waistcoat, a flannel shirt, a pair of short drawers, and a pair of stout trousers; also a pair of worsted stockings, and a tight-fitting round leather cap.

The Newcastle coal-field is the most important in quantity and quality which is now worked in England. The spread of this branch of industry is stretched over the greater part of the coast of Northumberland, and the whole of Durham. Twenty-two millions of tons of coal are raised yearly; sometimes in heaps, but generally in *strata* (a term given to extensive layers of any mineral substance, such as rocks, &c.). Almost everywhere coal is found in company with the same kind of rocks, and this is termed the *coal formation*. A *coal-field* means any extent of country over which it is spread.

Among the worst dangers to which a miner is exposed, any of which may arise from the least act of imprudence or neglect, are those of the roof and floor coming together, by the weight over the places where the coal has been worked out, and explosions of gas.

In coal mines *fire-damp* is frequently met with in old works and unventilated excavations, where it often mixes with a sufficient quantity of atmospheric air to cause an explosion. It is necessary to replace constantly the bad air with fresh, drawn from above, and this is done by making pits or galleries which open into the atmosphere; but when this is not sufficient for some extensive mines, in which the shafts are not near to each other, extra means are employed, such as large furnaces, (though these, without care, are dangerous where there is a discharge of fire-damp): air-pumps, large fans, and screws are also used. Water is a useful resource, and is frequently thrown down a shaft after an explosion of fire-damp, or when the air becomes dull, to aid the ventilation, which it effects, partly, by cooling the air.

You will understand, by what you have read, how the miner has to guard against danger from the four elements, viz., fire, air, earth, and water, and how important it is that he should exercise the greatest caution. It unfortunately happens that many are reckless and imprudent, and explosions in coal mines, and various accidents in metallic mines, lead to a fearful loss of life. It is very distressing to know that about *a thousand persons are killed annually*, and others are grievously wounded, in connection with mining operations, and this after so many remedial measures have been adopted to insure safety.

In coal mines, which are particularly subject to fire-damp, or highly inflammable vapours, the only light formerly in use was that produced from sparks by the contact of flint with steel, a wheel of that metal being turned rapidly round by hand, and a piece of flint being applied to it. This gave a miserable light, but it was the only method then known, and it required one person to work it for another person to work by; but this was not safe, for when the sparks fell upon any explosive mixture, a concussion took place, often fatal in its results. The consequence of this mode of lighting was, that the working of a large portion of the mine was prevented, and frequently more than one-half of the coal was left.

At length a *safety-lamp* was invented by Dr. Clanny, which removed some difficulties, but was not free from objections. Two famous men afterwards employed their great talents in endeavouring to make a lamp that would effectually prevent accidents. These were George Stephenson and Sir Humphry Davy. Stephenson, of whom we shall have more to relate, had been a common miner from his childhood, and had worked his way to different employments, in the same pursuit, by his steadiness and perseverance. His wife, one evening, came home, and found him lying at full length on the floor, trying a lighted candle against the wire-work of the fender, his object being to see whether the flame would pass through the openings. He had observed that when gas exploded in a mine, or in a long gallery, a certain time elapsed before the flame reached the other end, and he thought, that if small tubes were placed in the bottom of a lamp, through which the air that supplied it passed, and a chimney was attached to the lamp, the current of air passing into the lamp might be made, by the ventilation of the chimney, to pass so quickly, that an explosion could not, on account of that current of air, pass downwards, if the lamp was placed amidst inflammable vapours. After several experiments, a safety-lamp, on this principle, was constructed by Stephenson, and was first used in Killingworth Colliery, near Newcastle, where he had worked as a miner. This invention was considered so valuable, that in 1818 the people of Newcastle presented him with a silver inkstand and one thousand guineas. Sir Humphry Davy, one of the greatest discoverers in science that the world has produced, was led to the construction of the lamp that bears his name, and which is now in general use, by discovering that flame would not pass through the small apertures of wire gauze, being cooled by contact with the wire of the lamp. I will explain this by stating that if you hold a piece of close wire network over the flame of a lamp or candle, you will find that the flame will not pass through the openings. The wire may become red-hot, but no flame will appear above it; the reason being that the gas which forms the flame passes through the openings, but gives up, in so doing, so much heat to the metal, that when it escapes from the openings, or meshes, above the wire, it is no longer hot enough to be luminous.

The object of the safety-lamp is to enable the miner to walk, lamp in hand, in the midst of highly explosive gas, without the possibility of an explosion. This is effected by the Davy lamp, which is a common lantern, containing a lamp, or candle, enclosed by wire gauze instead of glass or horn, and of that degree of fineness that flame cannot penetrate. When this is carried into a place where fire-damp prevails, the outer air enters freely through the wire gauze, and burns quietly in the lantern, but the wire gauze which permits the cold gas to enter forbids the white-hot gas within to escape without parting with so much heat in passing as to mingle with the explosive air around. The lamp thus serves a double purpose; it is at once a protection and a warning. It protects, as you have read, and warns; because, the miner, seeing the gas burning in the lanterns, finds that he is surrounded with inflammable air, and measures are then taken to ventilate that portion of the mine, and prevent persons with open lights or candles from entering it.

The results of this invention have been an immense saving of life, and a great increase in the mineral resources of the country. In the counties of Northumberland and Durham alone, from three to four million tons of coal are now annually worked by the aid of safety-lamps, which could not have been done by candles, or by the steel mills which we have described.

The explosion in the Lund Hill Colliery in Yorkshire, in 1857, which caused a fearful loss of life, and the destitution of numerous poor families, was occasioned, it is believed, by the imprudence of the miners, who used open lights in all parts of the workings instead of safety-lamps. There are numerous other similar instances. But even with this means of preservation, a great amount of care is necessary, to see that the lamps are not out of order, or dirty with oil or dust, and that they are not dropped on the ground when red-hot. I have been thus particular in explaining the nature and use of the safety-lamp, for without it no great mining works could be undertaken.

It has happened, purposely and accidentally, that *coal mines have been set on fire*, and occasioned an immense loss of coal, besides other damages. The mines around Newcastle were ordered to be fired in 1643, by the Marquis of Newcastle, general of the king's forces then in the town, besieged by the Scots, whose commander, Leslie, preserved them by surprising the boats and the vessels.

In the grounds at Benwell, a short distance from the Tyne, a coal mine took fire through the carelessness of a workman who left his candle burning. The fire continued burning about *thirty* years, though at first it was so small that a proposal to put it out for a few shillings was not accepted. The fire afterwards raged with great fury, committing terrible ravages in its way, only conspicuous by its flames and columns of smoke in the night.

In 1849, a successful attempt was made to extinguish a fire which had been raging for a considerable time in the Astley coal mines, by means of carbonic acid gas, a process invented by Mr. Gurney. During 1852 another experiment was made, by the same gentleman, on a coal mine, long known as the burning waste of Clackmannan, in Scotland. This fire had raged for about *thirty years*, in a coal-field extending over a space of twenty-six acres.

This calamity is supposed to have happened through some persons who had been distilling illicit whiskey in the mine. Shortly after the discovery of the fire it extended rapidly, and threatened the destruction of the entire coal-field. A sum of sixteen thousand pounds was laid out, in surrounding the fire with a wall, to prevent its extending to other workings. This wall was finished in about five years, the workmen being frequently driven back, and obliged to recommence at a greater distance from the fire. In the building of this wall the lives of nine men and three women were unfortunately lost at various times, by the roof falling down and cutting off their retreat, and the fire overwhelming them before they could be extricated. One unfortunate girl was enclosed in this manner, and literally roasted to death. You will scarcely think it possible that such a fearful fire as this could be extinguished, and so thought most of the eminent practical miners of the time. Lord Mansfield, however, requested Mr. Gurney to make the trial, and, notwithstanding the immense extent of the burning waste, it was accomplished by a simple and inexpensive process.

Another very serious source of danger to the miner is when the *workings become overflowed by water*. This last may be occasioned thus: when the whole of the coal has been worked out of a mine, and the roof does not fall down, vast empty spaces are left, which often become filled with water, to the great danger of the mine which adjoins it. The quantity of water which flows into a mine is enormous, and it often happens that a mine becomes flooded by opening into such a place; the slightest fracture on the walls which separate the working mine from the old one is sufficient to flood the former entirely, and sometimes the wall has been made too weak to resist the pressure of the water, and is broken through, carrying death and destruction everywhere.

At a colliery near Newcastle, in 1815, about ninety poor fellows were shut up in the upper workings of a mine, by water breaking in from an old mine, which suddenly filled up the deep workings, and cut off all means of escape by filling up the shaft. Of course the miners were drowned. Two pits at Workington, in Cumberland, were suddenly filled with water, in 1837, by inundation from the sea; thirty-six men and boys, and as many horses, perished. Many other fearful accidents have occurred from overflowed mines.

Before leaving the subject of coal mines, I will relate to you a singular circumstance that occurred a few years ago at Parr (about fourteen miles from Liverpool), relative to the discovery of a coal mine. The anecdote will show you how extremely valuable such mines are which lie under a small extent of land. An elderly widow lady sold some property at Parr, consisting of a house and about thirty acres of land, to a gentleman, who purchased it for his own residence, for three thousand pounds. The old lady thought there must be coals under the land as there was so much in the neighbourhood, but it was the decided opinion of coal proprietors, and others who knew the locality, that there were not any coals in the property; or if there were, that they could not be got from the workings of any adjacent colliery, on account of part of the land constituting what is called a *fault*, namely, a separation of stone and earth, which sometimes happens, so as to separate deposits of coals from each other, and, consequently, they were of no value. The old lady, however, insisted that the coal, if found, should not go with the purchase, unless the purchaser would give her one hundred pounds for them, taking the chance of any being found. This was refused, and the coals were, accordingly, excepted from the purchase and reserved to the widow. The old lady died soon after, bequeathing the coal mines (in case any should be discovered) among the seven children of a deceased sister, all of whom were in wretched circumstances. The rest of her property—about three hundred pounds—she left to the children of another sister. The bequest of the coal mines was considered of no value whatever, and merely a fancy of the testator; and the possession of three hundred pounds in good money by the other children was looked upon with envy and dissatisfaction. The coal legatees brooded, for a long time, over their disappointment, but, at length, they contrived to induce some persons, who were supposed to have more money than wit, to undertake the expense of boring on the land to ascertain whether there were coals or not. The boring continued for a considerable time, to the great amusement of persons connected with collieries, but at last, to their great astonishment, and to the dismay of the purchaser, and the unbounded delight of the legatees, two beds of the best coal in Lancashire were discovered, extending nearly the whole length and breadth of the land, and easy to be worked. These coals were immediately purchased by the proprietors of a neighbouring colliery for *twenty thousand pounds*. On other borings being made, three lower beds were found, which the same parties purchased for *fifteen thousand pounds!*

The following lines, written by a miner "among the coal mines of Durham," are full of feeling and beauty:—

"Upon the hills the wintry wind is sighing:
In the dark vale where flows the winding Wear,
A hundred coal-fires burn
Beside the black-mouthed mines.

"And through the snow the sooty miners come
Down to their toil in the black vaults, where lurk
The gases that may burst
Into blue sulphurous flames.

"A sad, dark life! yet, labour has its joys;—
Pleasant the sight of heaven when work is done!
Pleasant the shining hut
Where burns the constant fire!

"But darker than the gloom 'mid seams of coal,
More to be dreaded than the fatal damp,
The night upon the mind,
The darkness of the soul.

"'Tis sad to toil afar from yonder sun;
But let the mind's true sun, *intelligence*,
Shed beauty, light, and joy
O'er every labourer's life.

"The enlightened soul can pour a cheerful light
Even through the mine—the unillumined man
Walks, in the face of day,
Surrounded with a gloom.

"To break this gloom—to shed the light around
Till every man shall feel its influence pure,
And share the common joy,
As one sun shines for all,—

"This be our task! As thousands toil for one,
So *one* must toil for thousands. Even a song
Can help the working hand,
And cheer the labourer's soul."

CHAPTER VI.

THE COPPER AND TIN MINES OF CORNWALL AND DEVONSHIRE.

COPPER and tin, two of the most valuable metals we possess, have been known from the earliest ages. If you refer to the Holy Scriptures, you will find frequent mention of the use of copper. Tubal-Cain is recorded as the first worker in brass (of which copper is the principal constituent) and iron (Gen. iv. 22). Palestine abounded in copper (Deut. viii. 9), and David left behind him an immense quantity of that metal, to be employed in building the temple (2 Chron. i. 22). Of copper, also, were made all sorts of vessels in the Tabernacle and Temple, weapons of war, &c.

We can scarcely wonder at this, for the ores of copper are either very heavy, or they have beautiful colours—purple, blue, and green,—and would, on these accounts, be calculated to draw very early attention.

In the earlier times, however, copper does not appear to have been employed by itself, but in admixture with other metals, principally tin, thus forming what is now called *bronze*. Copper was anciently most abundantly wrought in the isle of Cyprus, hence the origin of its Latin name, *cuprum*, from whence is derived its English appellation, copper. Of copper mining in England, in remote times, we have no authentic history; but it is probable, from certain rude indications in old and abandoned mines in North Wales, that copper was worked there by the ancient Britons. There is also evidence to show that the Romans worked copper mines in England;

and from the remains of these mines in Anglesey and Cumberland we may infer that mining was pursued by them with their characteristic skill and success.

Copper ores are found in great variety and abundance in Cornwall and Devonshire, but it was not until the middle of the last century that copper mining in this country received its greatest impulse. Mines were sunk to greater depth, new and powerful engines were constructed, the machinery improved, and the operations greatly facilitated.

Copper is one of those metals which are found in the greatest number of places, and in the largest quantity. Its ores are very numerous, the most common being a sulphuret, or combination of copper and iron, called copper *pyrites* (ores containing a large portion of sulphur), which occur in the north of Europe, in England (especially in the two counties I have mentioned) and Anglesey, and in many parts of Asia and Africa and the American continents. In 1844 a vein of very productive copper was found in South Australia. The Burra-Burra mine, in that country, is one of the richest in the world.

Native copper—that is, when it is quite pure and unmixed with other materials—is found occasionally in most copper mines. It is usually of a copper-red colour, but is sometimes discovered brown, black, and of various colours. It is either massive, or in grains and plates, or in thread-like filaments, in which shape it is frequently very beautiful. It is not often seen of a large size, although a mass of native copper has been discovered in a valley at the Brazils of two thousand and twenty pounds weight. In the Museum of the Academy of Sciences at St. Petersburg is a mass of native copper of an extraordinary size, found in Kamtschatka. Large masses have also been found in North and South America. One piece, in Canada, measures fifteen feet in circumference. Native copper has also been discovered in Siberia, Hungary, Austria, Sweden, and in Cornwall. In the latter place it is frequently found in the fissures of rocks, in thin threads, deposited by the impregnated water that runs from the layers of the copper ore.

Springs have been found impregnated with copper, and these, in later times, have been turned to advantage by the smelter.

The copper springs in the county of *Wicklow*, in Ireland, owed the discovery of their valuable quality to the following circumstance. About the middle of the eighteenth century, when the opening of the rich mines of Crone-Bawn had compensated for the loss of the more ancient workings of Ballymurtagh, a workman happened to leave an iron shovel in a part of the former mine, through which issued a copious stream strongly impregnated with copper. On taking out the implement, some weeks after, it was found so completely encrusted with copper, that it was at first supposed to have been converted into that metal. This accident suggested the advantage of laying bars of iron in the streams, by means of which the copper in the water was precipitated upon the iron, which became corroded by the process, and fell to the bottom as a reddish mud, and which, on being taken out and dried, appeared a sort of dust of the same colour, in which state it was ready for smelting. About five hundred tons of iron were laid at one time in these pits; in about twelve months the bars became dissolved, one ton of iron yielding a ton and a half, and sometimes nearly two tons of the deposit, and each ton of the latter producing sixteen hundred-weight of pure copper. It is a knowledge of this affinity between iron and copper that has furnished miners with a very simple but almost infallible method of ascertaining whether an ore contains copper. They drop a little nitric acid upon the mass, and, after a while, dip a feather into the acid, and draw it over the polished blade of a knife; if there is the smallest quantity of copper present, it will show itself on the steel.

Copper is used for a multitude of purposes. It is employed in making boilers, plating ships' bottoms, coining of money, for many operations of the coppersmith, and for its conversion into brass by being mixed with zinc. Although copper may be, and is to a considerable extent, cast in sand like other metals, it is in the state of *sheets* that the largest consumption takes place, especially when we consider what is required by the shipbuilder. Although copper is somewhat difficult to turn at the lathe, or to bore, on account of its clogging the tools, it is an exceedingly easy metal to turn into shape by hammering, being both soft and tenacious. It is capable of being thus made into leaves so thin, that in this state it is often sold in small paper books, in imitation of gold-leaf. This is employed, among other things, in covering children's toys.

Some articles, being first cast, are afterwards beaten out to the requisite degree of thinness, and to the form intended; advantage being taken of the metal being such as to spread without breaking, by repeatedly heating it until red-hot, and then gradually cooling whatever piece of work may be wrought in this manner. Other things, such as kettles, pitchers, and small vessels, in general, are soldered or joined by a preparation of brass and zinc. Copper tea-urns and sauce-pans are thus formed by soldering and hammering. The beautiful colour which you may have noticed in tea-urns is produced by the application of sulphuric acid, or Roman vitriol, previously to the burnishing. Copper vessels, when not very large, and particularly when intended to hold liquids or to dress food, are *tinned* inside. This is necessary, because copper, when long exposed to the air, becomes, in some measure, oxidized, or rusted, in which case its surface is covered with a thin blue crust, similar in appearance to verdigris; and unless copper vessels are kept perfectly clean and free from this rust, there is risk from poison. Copper is mixed with tin to make bronze and gun-metal and bell-metal: being highly capable of assisting sound, it is also used for making trumpets, and other musical instruments. Pliny, the Roman historian, tells us that the best looking-glasses were anciently made with copper and tin, but that in his time (soon after the birth of our Saviour) those of silver were so common that they were used even by the maid-servants. These metallic mirrors were highly prized among ancient nations; the Egyptian women, whenever they went to their temples, carried one of these mirrors with them.

Copper wire, on account of its elasticity, is used by rope-dancers. Large quantities are now employed for the electric telegraphs. Preparations of copper are used in enamel-painting, paper-staining, and in the manufacture of various colours. It is also used by the coloured glass-makers, and forms a beautiful green glass.

The malleable quality of copper, and its adaptability to the services of art, have seldom been more fully demonstrated than by Mr. Philips, of Snow Hill, London, in a work of very high merit. His figure of a "golden eagle" is the first attempt made to render feather for feather in either metal or stone in modern times. The eagle, which is of the natural size, stands on the summit of a rugged and precipitous rock, in a bold and threatening attitude. The whole figure is instinct with life, and has more the appearance of a real bird electrotyped by some miracle than anything else to which it can be compared. Every one of the minute feathers which cluster round the neck, the fine hair-like down which runs from the beak to the eye, the soft cushion of plumage at the junction of the wings and body, are here separate, *and can be each separately raised by the finger.* The half-hairy, half-feathery legs of the bird are wonderful in the fineness of the down which overspreads them. The most extraordinary triumph of Mr. Philips's skill, however, is shown in the extremely minute feathers which cover the frame of the pinions, and which conceal the fastenings of the large feathers forming the tips of the wings. It would be impossible to overrate this portion of the work, so numerous and so thick are the feathers, and so soft and deep is the effect produced. The rock which forms the eagle's stand,—a fine mass of tin and antimony in combination,—is of bold workmanship, and forms a pleasing contrast to the somewhat dusky colour of the plumage. Nothing can be more happy than the colouring of the figure of the bird. The metallic lustre of the feathers, so difficult to imitate in painting, is here rendered with great truthfulness. Equally good also is the horn-like appearance given to the beak and talons, while the yellow and wrinkled scales of the feet are life-like.

Mr. Philips was occupied for six years in bringing this curious work of art to its present condition. More than ten thousand feathers, formed from ordinary copper plate, all made by hand, some of which had to pass twenty-six or twenty-seven times under the hammer and the graver, were necessary for the plumage alone, and show the unwearied patience and industry of what has evidently been a labour of love.

If TIN is really intended by the Hebrew word,—which seems somewhat doubtful,—it is first mentioned in the Holy Scriptures among the metals which were to be purified by fire, found among the prey taken from the Midianites (Numb. xxxi. 22). It is also named among the articles of commerce which the Tyrians received from Tarshish (Ezek. xxvii. 12). The Hebrew word also denotes the mixture of lead, tin, and other inferior metals, combined with silver in the ore, and separated from it by smelting (Isa. i. 25).

From the most remote periods Cornwall has produced this metal in the greatest quantity. Herodotus, who flourished four hundred and fifty years before Christ, mentions the tin island of Britain by the name of *Cassiterides*, from a Greek word signifying tin. It is generally acknowledged that Cornwall and the Scilly Islands were visited by that great trading people, the Phœnicians (to whom I have already alluded), for tin, more than two hundred years before Christ, in which traffic they were, in course of time, joined by the Greeks and Romans. Some years before the invasion of Britain by Julius Cæsar, a Roman merchant named Publius Crassus encouraged the Cornish Britons to improve their mines, and increase their trade in metals with the Continent, and persuaded them to export their tin to France. His advice was taken, and even the islanders of Scilly (which is supposed at one time to have been united to Cornwall) are spoken of in the fourth century as prudent merchants, and of great skill as pilots, steering their frail vessels of skin with great dexterity.

Besides Cornwall (the chief repository of tin) and Devonshire, this metal is found in different parts of Europe,—amongst others, Bohemia, Saxony, Spain, and Portugal. It is also produced in large quantities in Asia, at Malacca and Banca, and Australia adds this metal to her other mineral riches.

Tin is never found *native;* it occurs in the oldest rocks, as granite, gneiss, and mica-slate, the veins running through them, or spread about in crystals through their mass. This is called *mine tin*, and that procured by washing alluvial deposits is called *stream tin*, the latter being the result of the wearing away of granite and other rocks which contained the veins of tin. Washed Cornish tin ore, usually called *black tin*, produces, on an average, more than half of metallic or *white tin.* Tin *pyrites* (ores containing a large portion of sulphur) are found in some of the Cornish mines. Ores containing copper are sometimes found with so large a proportion of tin, that it is difficult to say whether they should be regarded as tin or copper ores.

The purest variety of tin is called *grain tin*, on account of its granular columnar shape, which is developed by heating a mass of the metal until near its melting-point, and then suddenly letting it fall from a height upon a hard pavement, by which it is broken into the shapes above mentioned. *Block tin* is so called from its occurrence in the form of blocks or bars; although not so pure, it is extensively employed in manufactures. A third kind, called *Banca tin*, imported from the island of that name on the coast of Sumatra, is very pure.

Tin, although in itself the lightest of metals, is, in its ore, one of the heaviest. It melts with a gentle heat, and is sufficiently soft to spread under the hammer into thin leaves; yet it cannot be drawn into wire of any great strength. It is durable, not easily rusted or tarnished, and its bright clear colour is easily revived again. The uses of tin, besides those we have mentioned in connection with copper, are numerous. It is sometimes given in medicines, and preparations of it are made into cosmetics. A compound of tin with gold, and also with other metals, is employed to produce crimson, purple, and pink colours on glass and pottery, and dyeing scarlet. Tin enters into the composition of printers' types and pewter. One of its principal uses, however, is for covering sheet iron, which is manufactured into a thousand different articles for culinary and other purposes. This substance is well known as *tin-plate*. You know the old saying that "all is not gold that glitters." This is exemplified in one of the uses of tin-leaf. In the manufacture of gilt paper, gold is not employed; the paper is covered with tin-leaf, upon which is afterwards thinly spread a transparent lacquer, which is coloured yellow with saffron or turmeric.

The most ancient mode of obtaining tin was by the process to which I have alluded, called *streaming;* that is, as I before explained, by washing away the lighter particles of the soil where the metal is found in a stream of water, and allowing the tin to subside. The metal in its purest state is found in these stream works, also occasionally grains of gold, which are washed down with the inferior metal. After being washed and "dressed," the tin is sometimes subjected to heat in a *roasting* furnace, in order to clear it of other substances; and thi being done, it is prepared for the smelting-house. Copper ores are similarly treated as those of tin, excepting that as the copper is raised in larger masses, it requires less washing. The principal stream works in Cornwall are between Truro and Falmouth. Copper ore is broken small, picked, dressed, and placed in heaps ready for removal. Samples are taken, and the ores are sold, on certain days called "ticketing days," to agents of metal companies, by whom the ores are sent chiefly into Wales, for smelting, the vessels returning with coals for the mines. I will explain to you why this is done. Although Cornwall and Devonshire are so remarkable for the production of tin and copper ores, yet the want of coal in those counties renders it desirable to transport the metals to districts where coal abounds, as in South Wales, where there are extensive smelting works at Swansea and the neighbourhood. You will understand this from the fact, that for every ton of ore produced, about twenty tons of coal are required for smelting purposes.

Having thus explained to you the nature and purposes of copper and tin, I will now describe the mining operations by which they are produced.

What is called a *mine* comprehends generally every system of underground work or excavation, which has for its object the discovery and extraction of metallic ores, or other mineral substances. It will be well to mention how the presence of mineral veins, or, as they are termed, *lodes*, is discovered. I have related several instances in which mines have been found by accident. Such cases were numerous in former times. The gold mines of Galicia were laid open by the plough, those of India by the carting away of hillocks raised by the ants. Slight accidents, even in modern times, have been the cause of wonderful mineral discoveries. A great mine at Halkin, in Wales, was found by some labourers employed in cutting trenches, and another at Llangynnog, in the same country, by the slip of a woman ascending a hill, and laying bare the mineral vein with her feet. The silver mines of Argueros, in Spain, were first discovered in 1825, by a mule driver who was cutting wood on the mountain. He found, by chance, some rolled blocks of native silver, and on making this known, some miners went to the place, and collected a large amount of silver from the rolled stones they gathered on the surface. From that time until 1840, the mines produced annually about one hundred and twenty thousand pounds' worth of silver.

Such are some of the results of accidental discoveries. You will like to be informed how the presence of minerals is known to those who search for them. It was formerly believed that a forked hazel branch, in the form of the letter Y, cut at a particular time, was a certain means of discovering the position of mines. The fork was held in both hands, and carried over the ground suspected to contain ore, and no sooner was it passed over a vein or lode, than it pressed strongly against the hands—so it was affirmed,—and seemed to feel the same attraction as that which exists between iron and the magnet. Such, until within the past fifty years only, was a silly superstition connected with mining, now happily disappeared in the light of science and the progress of education. By the aid of *geology* (a term signifying the science of the earth) we are enabled to judge whether any particular district, from the nature and arrangements of its rocks, contains any beds of workable ores. Geology also indicates, to a certain degree, what substances may be probably met with in certain rocks.

In Cornwall, where, as I have told you, most of the copper and tin found in Great Britain is obtained, the rocks in which metals are found extend from the Land's End, in a direction from east to west, entirely along the country. The minerals are all found in veins, which are called *lodes*, to distinguish them from veins of *quartz* (a name given to numerous varieties of rock crystal), and other non-metallic minerals. These lodes are very irregular in size, and in the directions they take, although they usually follow one general line.

When a line is opened the men cut *drifts*, which are excavations made for a road underground, from north to south, to a considerable depth, by which means any intermediate lodes will be cut through.

In digging a mine the principal objects to be considered are the removal of the barren rock, or rubbish, the discharge of water—which is found, more or less, in every mine,—and the raising of the ore. Mountains and hills are dug with the most convenience, because drains and *adits*, or trenches, may be cut to convey the water at once into the neighbouring valleys.

In mines that are very deep, and below the adit, or conduit, that carries the water away, steam engines are used by which the water is brought up to the level of the conduit. In almost all the mines in England this work is done by steam; in Hungary and Germany hydraulic machines are chiefly used, and in some countries machines moved by horses, oxen, and even men, are employed. Until the introduction of powerful engines for pumping water, about the beginning of the eighteenth century, the miners could not proceed far with underground works. Some of the Cornish engines are very large, and, with the expenditure of one bushel of coals, can raise eight hundred gallons of water in a minute.

The immense quantity of water in many of the Cornish mines may be judged from the fact, that the various branches of the principal level in Cornwall, called the *great adit*, or conduit, which receives the waters of the mines in Gwennap, and near Redruth, measure *nearly thirty miles in length.* The water flows into a valley communicating with a small inlet of the sea, and is discharged about forty feet above high-water mark. In this method about *forty millions of tons* of water are raised by steam power out of the mines in Cornwall.

When the opening of a mine is determined upon, a *shaft*, or pit, is dug to extract the rubbish that accumulates at the bottom, draw off the water that drains in it, to facilitate the descent and ascent of the workmen, and to afford a means of ventilation, without which it would be impossible to proceed. This shaft is a hollow space, sometimes several yards wide, and varying in depth according to circumstances, whether the ground is level or on an elevation. The depth of some mines is truly wonderful; that of the salt works near Munden, in Prussia, is upwards of two thousand feet; and some of the coal mines in our own country are very deep; that at Monkwearmouth, near Newcastle, is upwards of eighteen hundred feet. It would scarcely seem possible that miners could work at such a great depth, but the temperature is not found to exceed the powers of human endurance.

As soon as the shaft is dug to some depth, a machine called a *whim* (which is worked by steam in some mines) is erected, to bring up either rubbish or ore, which is previously broken into pieces by pickaxes and other instruments; around this whim a hollow timber cylinder (a body having two flat surfaces and one circular) revolves, and this is called a *cage;* a rope winds around this, being directed down the shaft by a pulley fixed over it. By this means a bucket, or, as it is termed, a *kibble*—usually made of iron,—full of ore or rubbish, is hauled up, while an empty one is descending.

You will, no doubt, wonder how the miners are able to go down to their work through shafts of great depth. Until of late years these poor men were obliged to make use of ladders for this purpose, and the labour of climbing was so severe, that many were quite exhausted before they reached the bottom; and the fatigue of mounting, after their labour was done, was so great that their health was seriously injured; the young men frequently died of chest diseases at an early age, and the older workmen were obliged to labour in shallower mines. It was necessary that some means should be employed to remedy this evil; and the simplest idea was to apply, for the use of the miner, the same method that was employed to bring up the ore. But in 1833 a very different system, called a *man-engine*, was applied to some of the Hartz mines in Germany, consisting of two rods which moved alternately through the shaft, and from which the miner passed, first to one and then to the other, in his ascent and descent. In the following year this plan, much improved, was adopted in some of the Cornish mines. The rods, worked by a water-wheel, moved alternately, each having platforms about twelve feet apart. But in 1851 a single rod was found to act the best, and this was furnished with platforms, places for resting upon being made in the shaft on each side of the rod, so as to correspond with the level of the platforms. The movement of the rod is regulated by strokes from the engine, in such manner that the miner, on leaving a platform, waits on the resting-place in the shaft until the next up or down platform comes down to him. In this way the miner descends to his work without the exhaustion which the dangerous practice of climbing occasioned.

When the width of the excavations or galleries in the mine is not great, their sides can sometimes stand upright of themselves, but more frequently they require to be propped up by billets of wood, or by walls, built with bricks or stones, or even by stuffing the place with rubbish. These three kinds of supports are called *timbering*, *walling*, and *filling up*. These precautions are necessary to insure the safety of the workman, for the rocks amidst which he digs are seldom or never entire, but have always openings or fissures in various directions, so that without due care the fragments might fall in and crush him at any moment.

Another most important consideration is the means of *ventilating* these passages, for fresh air follows the miner with difficulty in the narrow places which he lays open, and there are also the respiration of the workmen themselves, joined to the smoke from candles, and gunpowder used in blasting the rocks, added to the gas from various substances found in mines. We will now suppose the miner to be at work underground, penetrating into the interior of the earth, and extracting from it the objects of his toil. The tools he makes use of are the *pick*, one side of which instrument is used as a hammer to break off pieces of rock. The point of the pick is of steel, finely tempered. The *gad* is a wedge of steel, to drive into crevices of the rock, or into small openings made by the pick, in order to loosen them. A pointed *shovel* is also used in order that it may penetrate into the hard masses of the rubbish. The tools for blasting the rocks with gunpowder are a *sledge*, or mallet, and a *borer*, an iron bar tipped with steel, and formed like a thick chisel, used by one man holding it straight in the hole, and turning it round, while another strikes the head of it with the mallet. The hole is cleared out from time to time by the *scraper*, which is a flat iron rod turned up at one end. When a rock is to be blasted with gunpowder, a hole is made ready for firing. This hole must be rendered as dry as possible by filling it with clay; a tapering iron rod which is called a *claying-bar* is then driven into it with great violence, so as to force the clay into all the crevices of the rock, and secure the dryness of the hole. When this is done, and a charge of powder introduced, a small taper rod of copper, termed the *nail*, is inserted, so as to reach the bottom of the hole, which is now ready for *tamping*, or cramming the hole; this is done with any soft species of rock free from flinty particles, and rammed in very hard with a *tamping-bar*, held by one man and struck with a sledge by another. The hole being thus filled, the nail is withdrawn, and a small perforation is left for the rush or fuse which communicates the fire.

Before the art of blasting rocks with gunpowder came into operation (in 1620), the method of applying heat to the rocks was by lighting fires upon them, to render them, thus softened, more yielding to the pick and the chisel. This was, however, a tedious process, and when gunpowder came into use mining operations became more expeditious and profitable. The gunpowder, when used, is put into paper cartridges, and inserted in the channel or passage left by the withdrawal of the piercer. This is exploded by means of a long match, which is lighted by the workmen, who then retire to a safe distance to watch the effect. In this manner the ore is blown out of the rock, and after each explosion wedges and levers are employed, to drag away and break down what has been shattered. Many accidents have, however, occurred by this method of blasting, but these may be prevented by the use of the *safety-fuse*, invented by the late Mr. Thomas Davey, of Tuckingmill, in Cornwall. This consists of a small train of fine gunpowder, twisted into the middle of a cord, and rendered compact by a counter thread, the whole cord being afterwards tarred. With this fuse shots may be fired into mines, under water, and in ice. They are lighted in the usual way, and communicate with the charge of gunpowder in the rock, after an interval determined by the length of the fuse. This invention has been the means of an immense saving of life and accidents.

The first *picking*, or *sorting*, of the broken pieces of rock takes place underground, and consists in separating the fragments containing no metallic matters from those that contain more or less of it. This the miner is able to tell from the weight of the pieces in his hand and their appearance. These are conveyed in kibbles or buckets up the shaft, and are afterwards again sorted on what are called *dressing-floors*, which are near the mouths of the principal shafts, in a shed or other building for that purpose. The pieces of ore are divided into small beds, on each of which is placed a thick plate of cast iron. On this plate, men, women, and children break the ores with hammers, then pick and sort them piece by piece. The rubbish is thrown aside, and the parts containing ore are then prepared for the stamping mill, to which I shall presently allude. On the dressing-floors a quantity of small rubbish remains after the sorting, and this is sifted, so that no particles of ore may be lost. The ore now undergoes the process of *washing*, to remove the lumps of earth that stick to it. There are several modes of washing; it is sometimes performed by men stirring, in the midst of a stream of water, with iron rakes or shovels, the lumps of ore placed in large boxes or basins of wood or iron. What is called a *buddle*, or tub, is also used for this purpose, with iron handles that are moved round about by means of a water-wheel. When the washing is finished, a door in one of the sides of the tub is opened, and the water removes the ore into a spacious basin, where it undergoes the process of *picking*. In some places it is passed through sieves to reduce the ore into powder, which is then stamped. A *stamping-mill*, or, as we may call it, a pounding machine, consists of several moveable wooden pillars, supported between frames. These pillars, having a mass of iron at each end, are moved up and down by a water-wheel in a sort of trough, by which the ore is pulverized.

When it is necessary to reduce ores to powder of an extreme fineness, they are passed under millstones, as in common corn-mills, and after being ground, they are bolted, so as to form a species of flour, or they are crushed between rollers.

The ore, after it is collected, is sent to the *smelting works*, and after it has been fused or reduced in the furnace, an aperture is opened, the cinders are removed, and a channel is made by which the melted metal flows from the hearth into a large vessel, where it is allowed to remain for some time. It is then ladled into moulds, so as to make large blocks or any other shape.

I have now conducted you through most of the important processes connected with metal mining, so that whenever you happen to visit one of these wonderful places, you will be able to comprehend most things that you may see. A mine constitutes a little world in itself, under the control of a principal manager, or, as he is termed, a *captain*, who has several assistants, and the superintendence of a large number of men, women, and children, who, in general, seem happy in their occupations, although these may frequently be severe and laborious.

From such a scene of industry we may ourselves learn to be cheerful and persevering in our own employments, whatever they may be:—

> "Work for some good, be it ever so slowly;
> Cherish some flower, be it ever so lowly.
> Labour! All labour is noble and holy;
>   Let thy good deeds be the prayer to thy God!"

CHAPTER VII.

ANECDOTES OF MINERS.

FROM what I have related, you will probably be glad to hear something more about the hardy and industrious men who pass so much of their lifetime underground. Working in such great depths of the earth, far removed from the cheerful influences of daylight, and surrounded with many dangers, would seem to most of us a fear ful occupation ; but Nature, kind mother of us all, gives a measure of endurance to the human mind and frame, which circumstances strengthen, and habit makes endurable. This is infinite wisdom, for without such assistance everything would be at a standstill, and all the wonderful works that man achieves would be wanting. It is a roving disposition that makes the sailor what he is; and as he, too, gets accustomed to his wild and perilous life, he passes carelessly through dangers that would appal a landsman. So with the miner; he also has *his* excitement in the discovery of metallic veins underground, and in working his way into deeper recesses, intent on his labour, and without the distraction of changing objects that arrest the attention above-ground.

The difference between mining in former days, and what it is at present, favours the pursuit of this occupation, and renders it less hard than one would suppose. The light of science has dispelled many of the evils that made mining a dreary labour in times past. The work is more equalized, the hours of labour are fewer, and the means adopted to ease manual work are more numerous and efficacious. Among the ancients, to dig in mines was considered the most severe punishment for criminals. The persecuted Christians who escaped from death were made to linger out a miserable existence in those dreadful places. They worked in water so stagnant that they frequently fell down dead. In the quicksilver mines, scarcely any workman survived after three years' exposure to the poisonous air, and an instance is recorded of one miner, whose system became so saturated with mercury, after being only six months thus engaged, that if he put a piece of brass into his mouth, or handled it with his fingers, it became white.

I will tell you what a Roman historian says of the condition of the poor slaves in the mines in his time. Not only the individuals themselves, but frequently their whole families, old men, women, and helpless children, were doomed to work in *chains* day and night. They had lamps fastened to their foreheads, and their bodies were painted. No attention was paid to their persons, and they had scarcely a rag to cover themselves, and so wretched were they that every one who saw them deplored their misery. No rest was allowed, even to the sick, the maimed, or the aged, but all were driven to their work by the lash, until, exhausted and overcome, they would perish in their toil. This description of suffering, as frightful as could be conceived, of miners in the earliest times, is very sad; but in all ages, until a more enlightened system prevailed (nor is this very far distant from our own time), the lot of the miner has been one of bitterness and severe labour, particularly in the case of forced work, as exists, for instance, in the mines of Siberia, where criminals and political offenders are sent from immense distances throughout Russia, far from their homes and families.

In my remarks on the silver mines of South America I stated that the number of Indians who died from *forced* labour during the course of three centuries is estimated at *nine millions.*

From this fearful picture we will now turn our attention to the miners of our own country in the present day. These men, generally speaking, are a bold, hardy, and intelligent race of men, differing in some peculiarities, according to the localities in which they are placed. The workers in the metal mines of Cornwall and Devonshire, especially the former county, which contains an almost inexhaustible amount of mineral wealth, are much changed in their manners and habits from what they were formerly, and this is owing in a great measure to the exertions of that great and good man, the Rev. John Wesley, who travelled incessantly among them, preaching the glad tidings of salvation, and exhorting the miners also to habits of sobriety and steadiness; for they had been among the most dissolute, dishonest, and irreligious class of people that could be met with. By his patient and earnest persuasions the Cornish miners were reformed; the Sabbath day, which had been habitually profaned, became respected, and the result of Wesley's efforts was the erection of numerous places of worship, which are now well attended, and preserve his memory as the miner's greatest benefactor. Wesley had many difficulties to encounter,—amongst others, the ignorance of many people, even in a higher class, impeded his progress. On one occasion he heard that one of his converts had been imprisoned; and on inquiring the reason, he was told "that the man's insolence had become insupportable, the fellow had had the impudence to say *that his sins were forgiven!*"

If you go into a mining district in Cornwall you will see, not far from the mine works, rows of neat little cottages, many of them built by the miners themselves after the work of the mine is done; most of them are extremely clean in the interior, and here you may find them seated at comfortable fires, frequently reading,—for most of them are intelligent and thoughtful men; or in the summer evenings they work in their little gardens or in the potato-fields, many of the cottages having a piece of ground for cultivation attached to them. Frequently they become experienced floriculturists, and at some of the flower shows that occur annually in several of the towns they often carry off the prizes. What a relief such pleasing pursuits must be to men employed for several hours in the day in the bowels of the earth, far removed from light and from wholesome air! Some miners also are expert carpenters, and make their own furniture, and those near the coast employ some of their leisure time in fishing. They are generally brave and courageous men, rendered so, in a great measure, by the nature of their employment. At least one-third of the crew of Captain Pellew's (Lord Exmouth, who was born at Penzance, in Cornwall) ship, that fought the gallant action with the *Cleopatra* French frigate (the first naval action in the last war with France), were Cornish miners, who had never before been to sea in a ship.

A pleasing anecdote is recorded of the honesty of a poor Cornish miner. There lived at St. Ives a lady named Prudence Worth, whose charity was remarkable. A miner, living at Camborne, had his goods distrained for rent, which he could not pay. He had heard of the many good deeds done by "Madam" Worth, as she was usually called, and he determined to apply to her for assistance. He said, "Madam, I am come to you in great trouble; my goods are distrained for rent, and they will be sold if I cannot get the money immediately."

"Where do you live?" inquired Mrs. Worth.

"In Camborne, and I work in Stray Park mine."

"I know nothing of you," observed the lady, "and you may be a drunkard or an impostor."

"Madam," replied the miner, with energy, "as I live, I am neither; and if you will lend me the money I will return it in four months."

The money was lent, the period of four months elapsed, and, true to his promise, the poor miner, notwithstanding that bad luck had attended him, had managed to get the amount borrowed together, and set off on foot with it. Arriving at Hayle river, he found the tide coming up, but to save a journey of three miles round by St. Erith bridge (for there was no Hayle Causeway then), he resolved to cross the water, which appeared to him shallow enough for this purpose. The poor fellow had, however, miscalculated the depth, and was drowned. When the body was brought to shore, his wife said that he had left home with three guineas in his pocket for Madam Worth. Search was made in his pockets, and no money was found, but some one observed that his right hand was firmly clenched. It was opened, and found to contain the three guineas.

I have given the bright side of the Cornish miner's general character, but there are exceptions, and, unfortunately, these are numerous. Many are of improvident habits, the prevailing evil of this class of men. Eating and drinking bouts, called "choruses," are too frequent, especially on Saturdays. A system of employing the men to work parts of the mine on "tribute," that is to say, the workman receiving for his labour a certain portion of the ores, which may happen to be found in the ground allotted to him for working in the mine, prevails. These allotments, or "pitches," as they are called, are let by auction to the lowest bidder, and are each taken by a party of miners, termed "a pair of men." This tribute work is let from month to month. Those parts of a mine which do not yield ore are generally done by job-work, called by the miners "tut," let by auction also, at so much per fathom, the usual measure in Cornish mines.

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Parties of men succeed each other in the mines during the twenty-four hours. Boys and girls, and weak as well as strong hands, find employment on the surface of the mine in various operations. The number of miners and subordinate work-people in one mine depends, of course, upon its extent, and may vary from twenty to a thousand and upwards.

The Staffordshire coal-miners are described as a curious race of men, tall and robust in no ordinary degree; but their faces, when the black is taken off, are ghastly pale; and even at an early age they are ploughed in the deepest furrows. Their labour is intense; they stand, sit, or crouch for hours working at the coal with their pickaxes. In speech and feature they are different from the peasantry of the neighbouring districts. They have also manners and customs peculiar to themselves; the use of nick-names, to almost the exclusion of the proper names, is common to them. So much was this the habit in former years, that clergymen have been known to send home a wedding party in despair, after having vainly endeavoured to obtain from the bride and bridegroom, or their friends, the correct Christian and surname of the parties, accustomed from their earliest youth to the sound of the nicknames only.

A different race of workmen from those of Cornwall and Devonshire are the miners, or pit-men, of the northern collieries; I allude more particularly to those in the neighbourhood of Newcastle-upon-Tyne, whose little cottages do not exhibit the same cleanliness and neatness that may be observed in the west of England; but a great improvement has been made in their condition of late years.

You will, no doubt, think that being so many hours engaged in laborious work, exposure to dust, dirt, and unwholesome air, would have a bad effect upon the health of the miners, but these are counterbalanced in some measure by the habits of many of them. The men work in warm flannel dresses, and after their labours are done wash themselves thoroughly. They have also many comforts in their houses, among which a more than abundant supply of coals is given to them, and they are able by their wages to provide sufficient supplies of wholesome food for themselves and their families; still the appearance of the miners shows the effects of their employment They are generally short and stunted, unshapely in figure, with hollow cheeks and unhealthy looks; so that, however a collier may get reconciled to his work (and they certainly do not seem eager to change), he must undergo great hardships, and his life is generally a short one, independent of the constant risks to which he is exposed in his subterranean labours. The author of "Our Coal and our Coal-pits" thus describes an evening in a pit village:—"Let us stand at the pit's mouth and see the colliers come up. Let us watch the old *hewers* (of coal) coming up in fours and threes, and the *putters* and big lads holding on to the rope. There, this time, you see a lot coming up hanging like a string of onions at a rope-end, the little lads sitting on their fathers' knees; and see, there is one little boy asleep! How striking an instance of confidence in his father's tenacity! That little fellow has fallen asleep while coming up nearly a thousand feet! 'Now, my lads, let's gang home;' and away they start, after having unlooped their legs, and stood upright on the bank a minute, by which time the little sleeper awakes, and puts his black little hand in a bigger black hand, and away they trudge homeward.

From the different hours of work for different persons, all the men and boys do not return at once, yet a considerable portion will be found up about five or six o'clock in the evening. Long strips of these semi-blackamoors may now be seen approaching the village from the colliery, towards their own 'Shiney Row,' as pit villages have been called by the men. You may see them carrying bottles, emptied of their cold tea or coffee, and provision bags collapsed by vacancy. Some come swinging Davy lamps about; but these are few, as the lamps are commonly taken care of in the pit. Whatever they carry in their long and oddly hung arms, you may know them to be pit-men, and by their gait and bend may form a shrewd guess as to their kind of labour. A hewer may be distinguished by his curved body, inclining to the shape of a note of interrogation. His legs will have a graceful bow, only it will be in the wrong direction. His chest will protrude like that of a chicken, his eye will have the glance of a hawk half awake, and his face somewhat the look of a pound of pit candles. The lads look either gawky, or slouching, or daring and careless; but, poor fellows, they have all had work enough, and I ought not to criticise them.

"Upon their entrance into their little cottages they proceed to strip and wash themselves, which, from the secluded character of the colliery villages, they see no harm in performing somewhat openly; but they have not much private room. Thus, as to time, the hour of retirement with workpeople in towns and cities is to colliers the hour of washing. It is as well to know this when you are passing a pit village at this time, if you have any dislike to soap-suds, which are now repeatedly thrown from the doors. Washing done, eating commences; and, as I have already stated, there is no deficiency of animal food and little luxurious accompaniments. One of these side dishes, or a second course, used to be, and is now sometimes, called a 'singing honey.' This is a rich kneaded cake, which has its name from the hissing noise it emits while baking on the girdle or gridiron. In olden times the 'singin' hinnie,' as they pronounce it, was quite indispensable.

"After taking a tolerable share of the good things set before them, the majority turn into bed, having to get up so early to work again. Perhaps you may see them again later in the evening, indulging in a slow sauntering walk, or a whiff of tobacco, or a scrape on the fiddle, or a blow at the flute, or a walk with a lass, or a wife, or a child.

"The lads and boys are now generally returned from the pit, and the majority of the working people are now at home. The youngsters will soon wash, and then contrive to obtain a tolerable meal, perhaps a very substantial one. In several instances, however, the younger boys, who have not become accustomed to the pit, experience a want of appetite and a painful aversion to food, which nature usually overcomes after long habit and presence in the mines. I regret to say, however, that some children never wholly lose nausea from pit work. Now, then, the washed and stuffed boys are seen to get a short game or two at play, just outside the doors, and the elder lads a lounge in the lanes or fields, and to take a turn at pitch-and-toss, or some less innocent amusement. A very short evening, however, will be that of the pit population. About nine o'clock, perhaps, fiddles begin to sound very inharmoniously; if possible, far more so than before. Attempts at quavers on the flute now begin to fail most suddenly, and familiar tunes become most painfully slow and drawling; lads have lounged in from the lanes; poor persecuted dogs and donkeys have peace and are voiceless; boys of all temperaments have become considerably less pugnacious; the tea meeting at Tom Jackson's, and the week meeting at Johnny Wilson's, have all terminated. Now, on all sides, there are unequivocal signs of settlement for the whole night. At about ten or eleven o'clock, nearly the whole of the colliery village is quiet or snoring. You have now, if awake, only the stars to gaze upon; if, however, you are near an eminence, pray step up and look over the neighbouring country, and see the pit heaps of small coal blazing in all their brilliancy. There is enough coal burning, perhaps, within a mile or two, to warm half the poverty-stricken houses of a town. The pit fires at night are very striking."

The cottages of the miners usually consist of two apartments, the principal one having a bricked floor well washed and sanded. The three principal, and most indispensable articles of furniture in the northern coal miners' houses, are a large four-poled bed, an eight-day clock, and a chest of drawers. The space beneath the drawers is the receptacle for loaves of bread of unusually large dimensions, but of good quality; whilst that between the ceiling of the apartment and the top of the drawers is always occupied with a lot of china teacups and saucers, piled up in the most fantastic manner, and exhibiting the inevitable consequences of total destruction in the event of suddenly slipping from their pedestal by accident or otherwise. On one side of the fireside is a small oven for baking cakes or other necessaries. To place every article worth seeing in as conspicuous a light as possible seems to be the ruling passion of the pitman's wife in household affairs. In some collieries the miners have formed themselves into friendly societies, for the purpose of providing against disease or accidental death. At some of the principal collieries the miners have among themselves bands of music, and have evening assemblies for practice. Thus far the picture of many of the northern coal mines has its favourable aspect; but there are dark sides also, and the worst evil is the sin of drunkenness, which prevails in many districts to a fearful extent, and occasions most of the revolting pictures of colliery life that are sometimes shown up to the public. A deep sense of religion and its moral obligations can alone check this maddening passion, and many good men and excellent societies are combining for the miners' benefit.

At Sunderland, the pit-men, at Christmas, appear as the sword-dancers, in white shirts and trousers, adorned with ribbons, and the captain, or leader, wears a faded uniform, cocked hat and feathers. The buffoon, or treasurer, has a hairy cap with a fox's brush. They sing old rhymes, the quarrelsome man of the party pretends to be killed, and the doctor brings him to life again: a dance round the swords completes this part of the ceremony. In Northumberland this play is called the "foud" (fool) plough, and sometimes the stot (steer) plough, with which they make long furrows before the doors of those who refuse to give them anything. On Sundays, the pitmen of Sunderland dress very carefully, having waistcoats with embroidered flowers, gaily coloured neck-handkerchiefs, shirt, short blue jacket, velvet breeches, worsted stockings, and low shoes.

The lead miners of the western district are a different race, much given to poaching on the rugged mountains and dreary moors, very independent in their tempers, fond of argument, and still retaining the good old custom (as in Cornwall) of singing hymns as they walk in procession at funerals. In former days the chief pleasure of the miners in these parts was having a fight with the weavers of Barnard Castle.

In the Wakefield and Methley colliery districts the miners have joined together to raise funds for investment in coal mines and other safe ventures, the proceeds of which are to provide for sickness and old age.

I have already mentioned to you that miners, owing to the unhealthy nature of their employments and their exposure to so many perils, do not generally attain the usual term of life, but an instance is recorded of a miner who died at the great age of one hundred and thirty-two years. I will give you some particulars of this extraordinary man.

John Taylor was the son of a miner in the parish of Aldstone, in the county of Cumberland, and was born about the year 1638. Having lost his father in his fourth year, he was set early to work in a mine, gaining twopence a day for some years by dressing lead-ore. He had been thus engaged for three or four years, and was about fourteen when the celebrated Mirk Monday occurred in 1652. The darkness of this day is well known to have been occasioned by an eclipse of the sun. At the moment when the phenomenon was commencing, John was at the bottom of a pit called Winlock shaft, and was called on by the man at the shaft-head, one Thomas Millbank, to tell those below to come out, because a great cloud had darkened the sun, so that the birds were falling to the earth. This event, which the old man invariably described with the same circumstances, was the single but satisfactory date for reckoning his age. John removed in his twenty-sixth year to the lead mines at Blackhills, in the county of Durham, where he was employed in watching an engine that drew water from the works. After nine years he was despatched by his masters, a Quaker company, to inspect and make a report of some lead mines in the island of Islay, on the west coast of Scotland. Here he acted for some time as overseer, working at the same time, and then returned to the north of England, from which he once more went into Scotland, being employed by Scott, of Harden, to make trials for lead ore in the vale of Ettrick. This latter work being dropped a year and a half afterwards, in consequence of the death of Scott, John had the good fortune, when on his way to Edinburgh, to coin the Scottish money into British, the union of the two countries having made that measure necessary. He wrought in the Edinburgh mint for two years, when, the work being entirely finished, he was re-engaged to work in the Islay lead mines; and there, in 1709, when about seventy years of age, he married his only wife, by whom he had nine children. John laboured at Islay until the mines were relinquished in 1730, when he found employment for two years in the mines of Strontian, in Argyleshire, until, being attacked by black scurvy, he found it expedient to remove to Glasgow. Here he had no resource but to become a day labourer, a kind of employment he did not relish, and he therefore went soon after to Hilderstone, near Bathgate, where the York Buildings Company was at that time exploring a silver vein. This work failing, John finally removed in 1733 to Leadhills, where he laboured regularly as a miner until 1752, having thus spent upwards *of one hundred years in unceasing work.* His great age and increasing infirmities then obliged him to desist from labour, and submit to be supported by his descendants. In October, 1766, when one hundred and twenty-eight years old, he walked from his own house to Leadhills, and having entertained his children and grandchildren at a feast, he returned the same day on foot. At no period of his life had he been accustomed to much sleep, and he had never known what it was to be idle. Even after having given up regular labour he would always have his hand at work, in some way or another, occasionally amusing himself with fly-fishing. He was always a thin, spare man, black-haired and ruddy-faced. His appetite was excellent, and when he was obliged to go to work, as miners are, at all hours, he found no difficulty of making as hearty a meal at midnight as at mid-day. He took for breakfast oatmeal porridge, and had meat and broth for his dinner; his chief drink was beer. At no period of his life was he addicted to indulgence in intoxicating drinks, and if his daily labour supplied as much as his family needed for their support, and kept him out of debt, no man in the world enjoyed life with a greater relish. At length, after being in a state of second childhood, with hardly any remains of either bodily or mental faculties, this veteran miner expired in May, 1770, at the age, already mentioned, of one hundred and thirty-two years, exemplifying the words of Beattie,—

"From labour health, from health contentment springs."

CHAPTER VIII.

SUPERSTITIONS OF MINERS.

"In the dark night of earth, 'midst gloomy caves,
The miner toils; a weary, anxious lot:
Dangers that menace life or limb he braves,
But turns with terror from some haunted spot
When the loose mould betrays the Pixey near,
The stamp or tread of tiny active feet,
Or the shrill cry or laugh rings on his ear;
Hasty he seeks a distant safe retreat,
While to his fev'rish mind the slightest sound
Awakes new terrors from the depths around."

THE history of the old British mines is mixed up, in rather a confused manner, during the first period of the Middle Ages, with the legends of fairies, dwarfs, and giants then commonly current; and superstitions of a varied character have lingered among the mining districts even to the present time. The singular discoveries that have been made in mines, the vast wealth that has been laid open, the isolation of the miners from the upper world, and the gross ignorance that long prevailed among them, and which still spreads a dark shadow over many mining localities, have all contributed to the indulgence of the imagination, and set reason at defiance. The British miners are not troubled, like their brethren in Germany, with visitations of kobolds and berg-geister, but they hear underground the noise of the "knockers," believed by some, as Mr. Kingsley informs us, to be the spirits of Jews who were sent to work in the mines by the Roman emperors, though the notion may be connected with those Jews who wrought the mines under the Plantagenet kings. These "knockers" were believed to haunt and exclusively dwell in the Welsh mines, where they partook of a homely and good-natured character, attracting the attention of the miner to the richest veins of ore, and working busily for his interest. From the size of these aërial beings we presume that they belong to an order of fairies, to which, we might think, good Bishop Corbet had bidden "farewell" long ago. They are described as "little-statured, about half a yard long."

The most curious account of the *knockers* is to be found in that repertory of curious information, the "Gentleman's Magazine." In the volume for 1754 are two letters on the subject by Mr. Lewis Morris, a person described as "eminent for his learning, and, in many respects, for good sense." "People," he says, "who know very little of arts or sciences, or the powers of nature, will laugh at us Cardiganshire miners, who maintain the existence of *knockers* in mines, a kind of good-natured impalpable people, not to be seen, but heard, and who seem to us to work in the mines; that is to say, they are the types or forerunners of working in mines, as dreams are of some accidents which happens to us. Before the discovery of *Esgair-y-Mwyn* mine, these little people, as we call them here, worked hard there day and night; and there are abundance of honest, sober people who have heard them, and some persons who have no notion of them or of mines either; but after the discovery of the great ore they were heard no more. When I began to work at *Llwyn Llwydd*, they worked so fresh there for a considerable time, that they frightened some young men out of the work. This was when we were driving levels and before we had got any ore; but when we came to the ore they then gave over, and I heard no more talk of them. Our old miners are no more concerned at hearing them blasting, boring holes, landing ore, &c., than if they were some of their own people; and a single miner will stay in the work, in the dead of the night, without any man near him, and never think of any fear or of any harm they will do him. The miners have a notion that the knockers are of their own tribe and profession, and are a harmless people who mean well. Three or four miners shall hear them sometimes, but if the miners stop to take notice of them, the knockers will also stop; but let the miners go on at their own work,—suppose it is boring,—the knockers will, at the same time, go on as brisk as can be in landing, blasting, or beating down loose earth, and they are always heard a little distance from them before they come to the ore. These are odd assertions, but they are certainly facts, though we cannot nor do we pretend to account for them. We have now very good ore at Llwyn Llwydd, where the knockers were heard at work, but have now yielded up the place and are no more heard. Let who will laugh; we have the greatest reason to rejoice, and thank the knockers, or rather God, who sends us these notices."

Shade of worthy Morris, we will *not* laugh, however monstrous the delusion that vexed thy troubled spirit. Many a poor miner, no doubt, found his labour lightened, and his long-deferred hopes revived by the cheerful tapping, boring, and blasting of his invisible friends, easing his way to the long-hidden treasures of the mine. Nor can we say that the belief is altogether extinct. It is not uncommon in deep mines, where there are what the miners call "vugs," or where there are large pseudo-morphous crystallizations, to hear loud and frequent explosions, and that on occasions and situations where no miners are at work; these noises are believed by some miners to be caused by the working of the *pixies*, whom they call "small men." The real cause, however, is the bursting open of some of the crystals, hollows, and "vugs," where the air or gas had been confined under very high degrees of pressure. A miner at Tavistock broke into one of these hollows, of considerable size and grotto-like appearance. It was richly studded with crystals of quartz and pyrites, which, by the light of his candle, had such a brilliant appearance as made the man exclaim, "I think I am in heaven!" On being asked in what respect it resembled heaven, he replied, "it was so beautiful, he could compare it to nothing else than a Jew's shop!"

But to resume,—the "spirits of the vasty deep" are not always of the genial temperament described. In Staffordshire there is a race of goblin miners, somewhat resembling the "knockers," who do friendly offices to the colliers, such as drawing up buckets of water and otherwise assisting them in their labours. In that county, however, the presence of these goblins is supposed to foretell some disaster, or, in a judicial sense, to express their disapproval of certain proceedings in the management of the mine. So the "swarth" fairy of the German mines has a dual character; one fierce and malevolent, the other gentle, "appearing as little old men, dressed as miners, and not above two feet high."

A sprite under the cabalistic name of Gathon is a troublesome foe to the miner, repeating blow for blow the stroke of his pick, or deluding him with false lights, noises, and flames. Such probably was the imp that frightened three miners in the South Devon Wharf mine some years ago. These men, while engaged at their work on a Saturday night, suddenly saw a large ball of fire issue from a rock, and with a rumbling noise advance towards them. On its approach it assumed a variety of forms, sometimes that of a human figure, then of a church, with arched windows, pillars, &c. The men were of course mightily terrified, and conscience reproaching them that Sunday had commenced on their unfinished labours, they fully believed they saw and were pursued by an evil spirit. The fact is, that it is not very uncommon for inflammable gas to issue from the backs of lodes, which ignites as soon as it comes in contact with the oxygen of the atmosphere. The ground where these men were working was full of iron and tin lodes, and there can be no doubt that their fears not only gave the name, but also the shapes to the meteor.

The poisonous exhalations that are sometimes encountered in mines, would probably also produce the phenomena and effects—on minds ignorant of natural causes—described by Dr. Morret, in his account of the Cornish mines published in the "Philosophical Transactions." "The labourers," he tells us, "have stories of *sprights of small people*, as they call them; and that when the damp arises from the subterraneous vaults, they heard strange noises, horrid knockings, and fearful hammerings. These damps render many lame, and kill others outright, without any visible hurt upon them."

Shakspeare addresses the—

> "Elves of hills, brooks, standing lakes, and groves"

and those—

> "Whose pastime
> Is to make midnight *mushrooms.*"

We may conclude that fairy butter was not known in his time, and was a later superstition; but that industrious gleaner, Pennant, mentions that there is a substance found at a great depth in crevices of limestone rocks in sinking for lead-ore, near Holywell, in Flintshire, which is called *Menyn, Tylna, Teg*, or fairies' butter. This is a substance of nature's own churning, but it affords a proof how strongly the "little people" kept their hold on the imaginations of miners as well as others.

Vegetables growing in mines possessed certain talismanic powers among the German miners; so Lord Bacon tells us, and no one was allowed to gather them. The same writer tells us, in his "Sylva Sylvarum," that "in furnaces of copper and brass where chalcite is often cast in to mend the working, there riseth suddenly a fly, which sometimes is seen moving, and dieth presently as soon as it is out of the furnace."

Mine legends would be incomplete without a dragon, that terrible *bête noir* of our forefathers:—

> "Old stories tell how Hercules
> A dragon slew at Lerna,
> With seven heads and fourteen eyes
> To see and well discern-a."

Accordingly we find that the Indians in the neighbourhood of Esmeraldas, in South America, still retain the dread of an enormous dragon that is said to guard the emerald mines.

The Arabs entertain the same superstitious fears with regard to mines that the ancients did, with the slight difference that mythological belief established.

M. Caillaud, in his exploration of the mines at Mount Zebarah in Egypt, was cautioned against sleeping near the caves, as they were said to be the refuge of snakes and other beasts of prey, and the abode of demons who would resent any intrusion into the mines. The Arabs, finding the traveller resolute in his determination to enter the caves, kept up a constant firing of guns to keep off the evil spirits.

From a dragon to a spider is a wide stretch of fancy; but an evil spirit in the latter shape holds his own in Sardinia against even the sturdy miners. It seems that an ancient lead and silver mine between Villa Cidro and Vill Ermosa, has been neglected and allowed to be filled with water, from a dread of the "solifuga," a small venomous spider, so named from its avoiding the sun and haunting the darkest recesses of the mine, and whose bite is considered to be mortal. This tradition, however, belongs to a remote period, for Agricola mentions certain little animals resembling spiders which he calls "lucifega," from a similar reason to that given above. "These animals," he says, "haunt chiefly the silver mines." The same writer tells us that "demons and ghosts terrify the miners, and that this sort of apparitions cannot be prevented without prayer and fasting." Ramazini, the learned professor of Padua, who wrote on the diseases of artificers, observes on this point, "I took this story of devils haunting mines to be fabulous till I was undeceived by a skilful Hanoverian operator in metals, who is now employed by our duke in tracing the metallic veins in the mountainous parts of Modena. For this man told me seriously, that in the Hanoverian mines the diggers have frequent falls, which they say are occasioned by their being knocked down by devils, which they call

Knauff-Kriegen, and that after such falls they often die in the space of three or four days, but if they outlive that time they recover."

All this is very curious, and it is a relief for us to think that such things belong to a different age from our own. "Poor fellows," we may exclaim, "what dark times they lived in! How different from the enlightened present!" But softly,—we take up a Merthyr paper, of no very late date be it understood, and here we read how superstition is still rampant among the miners. It is true, it is only that old bug-bear the corpse-candle, that has turned many a head in the upper air as well as in the lower, but still here it is. A vision of this description, we are told, scared "the pit from its propriety," and drove a poor miner away from his work. A hauler employed in Cyfartha works saw the apparition three times in the shape of an unsubstantial tram-road, upon which, drawn by an aërial horse, followed a train, not of iron, but of the same stuff with that which floated as an "air-drawn dagger" before the eyes of Macbeth. Within this immaterial carriage lay the body of a man, mute, motionless and death-like. Twice did the noiseless apparition emerge, as it were, from the earth, and twice was the warning neglected; at length, on its third appearance, the spectator plucked up courage, gazed upon the face of the spectre, and recognised the well-known features of a companion. To slight such a manifestation would have been tempting his own fate. The substantial miner was apprised that his shadow had appeared without his permission, and the following day he fled from his fate to another colliery. The Merthyr paper from which we obtain this intelligence adds, as a fitting corollary, that "the other colliers ceased to work for a day, but whether the beer-houses were gainers by their fears" (which is most likely), "or whether the supernatural *bier* kept them at home in solemn meditation, we have not been told."

The belief in apparitions still exists among the miners of Dean Forest, that picturesque hilly tract in the west of Gloucestershire. The Dean miners were once a lawless set, leading a wild life in their sylvan solitudes, and not only enjoying many ancient privileges granted to them, but others of their own creation, giving much trouble to the Government in consequence. Many of these forest miners also regard sickness and accident as fatal and inevitable. "Ill-wishing" and "over-looking," which are nearly identical with the "evil eye," are delusions still existing in Cornwall. A sinister look or a muttered expression of discontent is carefully treasured up by the object of it, and any mischance which follows is set down to the score of "ill-wishers."

If a Cornish miner on his way to night-work meets a stranger, and receives no answer to the customary "good-night" greeting, he reckons it an omen of ill-luck or something worse. Whistling in mines is on no account permitted, a superstition shared in by seamen as well as miners. Many miners object to enter a mine on Good Friday, Innocents', and Christmas days, fearful that some catastrophe would attend the breaking of a prescribed custom.

On Christmas Eve, the pixies formerly assembled in the deepest mines to hear the midnight mass. Voices of unearthly sweetness sang the solemn service, and as the grand music swelled and shook the depths, the rough surface scaled off from the rocky sides of the mine and disclosed walls, diapered with ore, and glittering like gold in the light of myriad torches. Here would be a subject for scenic display, worthy the genius of Beverley and others who have made fairy haunts familiar to us.

One of the most firmly rooted beliefs in the mind of the miner was a faith in the *divining rod*, nor would we undertake to say that this delusion does not exist at the present day. Most certain it is that the *dowsing* rod, as it is also called, was used in Devonshire, at Sticklepath, near Okehampton, in the year 1829. A *dowser* was brought up at a considerable expense from Cornwall by a set of mine adventurers, who notwithstanding the favourable indication given by the dowser, found their speculation unfavourable. The *virgula divina*, or *baculus divinatorius*, or less romantic dowser, was a forked hazel branch in the form of the letter Y, cut in a planetary hour. Jupiter, Venus, Sol, Saturn, or Mercury, was concerned in the operation. Jupiter, or *Pars Fortunæ*, was to be in conjunction, sextile, or trine, to the lord of the ascendant or second, and the better if any reception happen; but *beware* if it be not by opposition, for that spoils all! Under such astral influences was the hazel branch to be cut, and then came the *modus operandi*: the fork was held in both hands, and carried over the grounds suspected to contain the ores. The branch went unaffected over all the barren spots; but no sooner did it impend over a vein than it pressed strongly down, and, as I have before mentioned, seemed to feel the same attraction as exists between the iron and the magnet.

Droll enough, it seems that good health, and when the operator is in good spirits after meals, secures a better chance of success, at least so a writer in the *Gentleman's Magazine* for November, 1751, informs us.

From rod divination to dreams is an easy transition, and with this I will conclude the present chapter.

Golden dreams are common to all of us, but the product they yield is momentary pleasure only; not so with *tin* dreams, which on some occasions, as Carew, the Cornish historian, informs us, have produced substantial results. "Somme," he says, "have found tynne-works of great vallew through meanes no lesse strange than extraordinarie, to wit, by dreames. As in Edward the Sixt's tyme, a gentlewoman, heire to one Tresculierd and wyfe to Lawyne, dreamed that a man of seemly personage told her how in such a tenement of her land she should finde so great store of tynne as would serve to enrich both herselfe and her posteritie. This she revealed to her husband, and hee putting the same in triall, found a worke which in foure yeares was worth him welneere so many thousand pounds. Moreover, one Paprel, lately living and dwelling in the parish of the hundred of West, called St. Niot, by a lyke dreame of his daughter (see the lucke of women), made the like assay, met with the effect, formed the worke of the unwytting lord of the soyle, and grew thereby to good estate of wealth. The same report passeth as currant touching sundrie others."

CHAPTER IX.

PERILS AND ESCAPES OF MINERS.

The miner, in the pursuit of his daily work, is so frequently exposed to danger, that his life appears to be in continual jeopardy. I will relate to you a few instances of very narrow escapes from death. In the winter of 1815, at *Hucklow*, in *Derbyshire*, a man of the name of Frost was engaged in one of the mines, and while thus occupied a large mass of earth fell in, and he was buried beneath. His companions soon hurried to the spot and heard his voice, by which they ascertained that his head and his body remained unhurt, the principal weight having fallen upon and bruised his thighs and legs. Great care was required to effect his release, and some of the most experienced miners were employed for that purpose. A mass of earth had been stopped in its fall, and hung suspended over the head of the poor man, ready at the slightest touch to crush him to pieces. The miners, aware of his great peril, were not able to attempt his release by the most direct and expeditious means of removing the earth over him, but they were obliged to dig through the side of the pit, and make a gallery, in order to reach the place where the man was lying, and this occupied them from Monday, the day when the accident took place, until the evening of the following Thursday, when they were able to release poor Frost from his dreadful situation, after a temporary burial of seventy-five hours. He had received a few slight bruises, but a mass of stone had fallen upon one of his legs and crushed it. A few drops of water that fell near his head, and which he contrived to catch in the hollow of his hand, allayed his thirst, and no doubt contributed to his preservation. He was cheerful even in the midst of his great danger and pain, for Frost was a religious man, and placed all his confidence in the merciful God who saved him from death. He was removed to his home, and with careful treatment recovered his strength, and the loss of a leg did not prevent him from pursuing his work in the mine.

The *Godbeheres Founder mine*, in Derbyshire, is rendered memorable from an occurrence that took place there about sixty years ago. Two men named Boden and Pearson were working in the mine at different depths, when the earth and water suddenly rushed in upon them, and in one moment buried them alive in the deep recess below. On the third day after this accident happened Pearson was found dead among the rubbish, and the men who were employed in clearing away the earth that had closed up the entrance to the mine had now so little hope of finding Boden alive, that they were scarcely disposed to pursue their labours. They were, however, prevailed upon to proceed, until, on the eighth day of their work, they distinctly heard Boden's signal, and ascertained that he was living. They now worked with greater energy and with more care, and after a few hours they found the object of their search, almost exhausted, but still in existence, and fully aware of the providential nature of his escape. His recovery from the effects of this premature entombment was slow, but effectual, and he returned to the mine in about thirteen weeks, and lived many years afterwards. When the accident took place Boden was in the lower part of the mine; Pearson was in the drift above when the earth fell upon and killed him. Boden's situation was equally perilous, but the earth was stopped in its fall by a projecting mass of rock, and this saved his life. In this situation, with no prospect before him but death, the poor man passed *eight* days in his narrow cell without light or food, or wherewithal to quench his thirst, which he felt more severely than any other deprivation. Hunger he bore with fortitude, but thirst was intolerable; and during the whole of his confinement he was sufficiently sensible to feel all the horrors of his situation. He likewise suffered greatly from cold, but having a few yards to move in, he found a windlass (a handle by which a rope is turned), and exercised himself in moving it round, but by some mishap the handle fell into the shaft below, and he could not recover it again. Deprived of this means of employment, he still found something to do. In that part of the shaft where he was imprisoned a rope was suspended over his head; he clambered up it, and working at the earth above him he loosened a portion, which fell into the chasm at his feet. While he was thus engaged, he thought he heard the noise of men iabouring to release him; he listened again, almost breathless with anxiety. The sound for a time almost paralyzed him. Shortly afterwards he saw the light of heaven, and human faces gazing upon him, as if they had actually beheld a man rising from the grave, and not a living body. He was, indeed, little more than a skeleton compared to what he had been, for mental and bodily suffering had so reduced him, and the pallid hue and altered expression of his countenance had nearly obliterated his personal identity. In this state he was restored to his friends. Boden kept the anniversary of his deliverance from his subterranean prison as a day of thanksgiving to the Almighty for his wonderful preservation.

Haycliff mine, in Derbyshire, now no longer worked, once contained an extraordinary mineral, called in that part of the country *slickensides*. It is a species of *galena* (a metallic-looking substance of a lead-grey colour, consisting of sulphur, lead, a little iron, and sometimes a small quantity of silver), and highly explosive. The effects of this mineral are not less singular than terrible. A blow with a hammer or a scratch with a miner's pick is sufficient to rend the rocks asunder, wherever it is found united to or embodied in them. The stroke is immediately succeeded by a crackling noise, accompanied with a sound not unlike the mingled hum of a swarm of bees. Shortly afterwards an explosion follows, so loud and frightful that even the miners, though a hardy race of men, and little accustomed to fear, turn pale and tremble at the shock. The greatest caution is therefore necessary in working mines where this mineral is found. To avoid the use of the common instruments of mining, a small hole is carefully bored, into which a little gunpowder is put, and exploded by means of a long fuse. The workmen then withdraw to a place of safety to wait the result of their operations. Sometimes not less than five or six successive explosions occur at intervals of a few minutes, and occasionally they are so awful that the earth has been violently shaken to the surface by the concussion.

When the Haycliff mine was opened, a miner, who was unused to the effect of this dangerous mineral, and who was of careless habits, was repeatedly cautioned not to use his pick in getting out the ore, but, unfortunately for himself, he paid no attention to the advice of his fellow-workmen. He struck the fatal blow, that, apparently by an electrical communication, set the whole mass in motion, shook the surrounding earth to its foundation, and with a noise like thunder scattered the rocky fragments in every direction. Boards of ash, distant twenty or thirty paces, of enormous thickness, were perforated by pieces of rock. The poor man was dreadfully cut and lacerated, but, providentially, escaped with life, and he could never be persuaded afterwards to return to his mining employment.

Sometimes *earthquakes* have occurred, and the shocks have very greatly terrified the miners at their work, although I do not know of any instance in which they have been fatal to those underground. It has been remarked as a curious and interesting fact, that the great earthquake which, on the first of November, 1755, destroyed nearly the whole of the city of Lisbon, was very sensibly felt in many parts of Derbyshire, and particularly in the lead mines near Eyam. The narrative of Francis Mason, an intelligent overseer of the mines on Eyam Edge, has been published. About eleven o'clock on the forenoon of that day, as Mason was sitting in a small room, about fifty yards distant from the mouth of one of the engine shafts, he felt the shock of an earthquake so violent that it raised him up in his chair, and shook some pieces of lath and plaster from the sides and roof of his little hut. In a field, about three hundred yards from the mine, he afterwards observed a chasm, or cleft in the earth, which he supposed was made at the same time. Two miners who were employed underground about three hundred and sixty feet, when the earthquake took place, were so terrified at the shock that they did not attempt to climb the shaft, for fear the earth might fall in upon them and bury them alive. They felt themselves surrounded by danger, and as they were conversing with each other on the means of safety, and looking for a place of refuge, they were alarmed by a second shock, much more violent than the preceding one. They now ran quickly into the interior of the mine; it was an instinctive movement that did not in any way better their condition, but their danger and their fears were still the same. Another shock ensued, and, after an interval of four or five minutes, a fourth, and afterwards a fifth shock occurred. Every shock was followed by a loud rumbling noise, which continued for about a minute; then gradually decreasing in force, like the thunder retiring into distance, it subsided into an appalling silence more full of terror than the sounds which had passed away, leaving the mind, unoccupied by other impressions, to contemplate the mysterious nature of its danger. The whole space of time included between the first and the last shock was nearly twenty minutes. When the men had recovered a little from their terror they began to examine the passages, and to endeavour to extricate themselves from their confinement. As they passed along the drifts they observed that large pieces of minerals were scattered along the floor, which had been shaken from the sides and the roof, but all the shafts remained entire and uninjured.

A remarkable phenomenon took place in the deep *silver mines of Marienberg*, in Saxony, at the beginning of the present century, when shocks of earthquakes drove the miners in alarm to the surface, where, meanwhile, nothing of the kind had been experienced. A contrast to this was experienced in 1823, when the miners at Palen and Presburg felt no movement whatever, whilst above their heads a violent shock of earthquake spread terror among the inhabitants on the surface.

The following melancholy event, and extraordinary deliverance from one of the most horrible deaths that the mind can conceive, occurred in the *Staffordshire collieries* about the year 1816.

About midway between the towns of Wednesbury and Bilston, on the great Holyhead Road, is one of the finest beds of bright red sand in the kingdom. This bed of sand is many yards thick, and being extensively used in the iron foundries, hundreds of boat-loads were taken away for that purpose. A little to the left of this spot, on a Monday morning, about the period before named, and whilst the miners were busily occupied in the coal mine underneath, a sudden "crownings-in" (as it is emphatically termed by the colliers), or falling in of the superincumbent strata, took place about the centre of the works, owing, as was supposed, to the bearings that are usually left being too much weakened to support the heavy mass above. At this moment about fourteen or sixteen men were at work below, nearly all of whom were then employed at the extremity of the mine, and the disrupture happening about midway between the shaft of the pit and the situation where the workmen were engaged, the drift-ways were instantly filled with the falling mass, and consequently all escape was cut off, and their lights were extinguished by the violent concussion of the air. The few workmen who happened to be near the bottom of the shaft were instantly drawn up to the surface. The alarm was given, and spread like wildfire through all the surrounding working districts. Thousands were seen rushing to the fatal spot as to a common focus,—fathers, mothers, wives, and children by their cries adding to the misery of the scene. Nearly all work in the neighbourhood was suspended, both employers and workmen assembling to render assistance. Of course the fate of the ten or eleven men stopped up in the mine was all matter of conjecture. Whether the fallen rubbish had choked up the further workings and buried them alive, or, supposing this not to be the case, whether they could exist without food or fresh air until their deliverance could be effected, was equally matter of doubt. After some consultation the engine was set to work, and parties of workmen went down into the pit, in the hope of clearing away the rubbish below, so as to get to the unfortunate men, whilst loads of fagots and straw were emptied into the hollow formed on the surface by the fall (which resembled an inverted cone of from fifteen to twenty yards in diameter), for the purpose of stopping up the fissures, and preventing the running down of any more loose sand from the top. This course was persevered in for some time, but it was at length found that their labours were ineffectual, as sand, water, and rubbish kept pouring down as fast as it could be removed from the bottom. Another consultation was now held, when the only hope of saving the men was, the driving ahead through the solid coal, in a winding direction, round the fractured part, into the farther end of the mine. This was a work of great labour and difficulty, as nearly one hundred yards in length of solid coal was necessary to be penetrated by the shortest possible cut. Subscriptions were raised, and the different masters set a laudable example to their men by their personal assistance. Working gangs were formed sufficiently numerous to relieve each other by short relays. This undertaking was instantly commenced with the greatest alacrity on the part of the workmen, some cutting away with their picks, others clearing away the coal from behind—the men retiring to rest as they became fatigued, and their places occupied by fresh hands. The head was driven no larger than was necessary for the men to sit to their work, and resembled a tunnel. Day and night the work proceeded until the close of the week, the public anxiety increasing as the cutting advanced; the absorbing question, early and late, being, "Has anything been yet ascertained about the fate of the unfortunate colliers?"

On the following Sunday a rumour was spread that the men engaged in driving had heard sounds from within like the distant tapping of hammers, and at length this sound became more distinct as the work proceeded. All was now increased activity. They were no longer labouring without strong hopes of saving some of their fellow-creatures, and this feeling stimulated their exertions. Early on Monday morning (one week from their incarceration) it became generally known that voices had been heard within, audible enough to warn the drivers, who, in their anxiety to shorten the cutting, were approaching too close to the fracture, to keep more to the left. It was pretty well understood, also, for some miles around, that the head would be driven through in the course of that day, and again the neighbouring population poured to the scene in countless numbers, the diverging roads presenting one moving mass.

About one o'clock in the afternoon the head was completed, sufficiently large to allow the workmen to enter, when *nine men and one boy were found*, alive, indeed, but in the last stage of exhaustion! The news was instantly communicated to the assembled crowd above. At this awful moment the sensations of the assembled relatives of these unhappy men were most intense. One poor woman, it was stated, had died with excess of joy upon learning that her husband was still alive, after a whole week of the most agonizing suspense. Medical practitioners were in attendance, and by their directions the air was admitted into the confined portions of the works by degrees; warm gruel and other restoratives were carefully and sparingly administered to the sufferers down in the works. After a proper interval they were gradually brought out, enveloped in blankets, drawn to the surface (each in the lap of a sturdy miner), instantly put into coaches which were ready in waiting, and conveyed to their respective homes. It was now ascertained that one miner and a horse or two had perished. One poor fellow was passing through the drift-way at the time of the fall, and was buried in the rubbish, but not so completely as to cause instant death. He lingered for some time; and his unfortunate companions, unable to render him assistance, heard his cries for help, as they became gradually weaker, until they became extinct in death. It also appeared that the sufferers had made a fruitless effort to effect their own deliverance, by removing the fallen earth as long as their strength would permit. They had taken a meal with them, as is usual with colliers when they descend a pit, and had caught a little dropping water in their caps, which had helped to allay their thirst; and this was their only sustenance during the seven days and nights that they were stopped up; but they had also heard the blows of the pick as the head was being driven through, and the hope that their deliverance would be effected had doubtlessly contributed to sustain their sinking spirits; nevertheless, had any relaxation taken place in the efforts that were made for that purpose, the consequences must have been fatal to them. One man had a son with him in the mine, a boy of thirteen, who sat upon his father's knees, and slept the greater part of the time, occasionally waking and crying for his mother, then falling asleep again. One remarkable fact is that on being asked if they knew the day of their deliverance, they supposed it was on the Friday. It would be naturally thought that in their dark and dreary confinement time would have dragged on so heavily, that they would have supposed the duration longer than it actually was; but it is probable that the close and half-stifled nature of their situation brought on drowsiness, and that they had all slept more or less. It is gratifying to know that all the poor miners ultimately recovered.

On the 2nd of May, 1818, a number of colliers were working in the *Quarrelton coal-mine*, near Paisley, when a stroke from one of their pickaxes suddenly opened a passage for a vast quantity of water which had been collected in a neighbouring pit, long since disused. A large stream immediately poured into the place where they were working, sweeping everything before it with the violence of a rapid and swollen river. The men fled with precipitation, and, crying aloud, sent the alarm through the pit. Struggling with the growing force of the stream, which threatened to hurry them along with it, and in the confusion having most of their lights dashed from their hands, all rushed instinctively towards the bottom of the pit. Out of twenty, thirteen reached the bucket, and were drawn up; one of whom, so narrow was their escape, had been twice thrown down by the violence of the current. Seven of the men were yet in the pit, but the water soon rose above the mouth of the mine, and their communication with it was cut off. For these men the most lively concern was felt by their companions, and the progress of the water was anxiously observed. The engine connected with the pump was set in motion; but although the quantity it drew up was immense, yet the water for some time rather increased than diminished. The only way in which they could assist their unfortunate fellow-workmen seemed to fail them, but they consoled themselves with the hope that they might have escaped to a higher part of the mine, an upper tier of rooms, which they knew to be still above the reach of the water. The knowledge of this fearful accident was by this time rapidly spreading over the country; and as it passed from village to village, and cottage to cottage, excited in every breast a mingled sensation of sympathy and horror. Crowds were soon seen gathering from every quarter towards the spot, and relating to each other, as they went, the numerous reports which now began to circulate; and on reaching the pit they seemed to look with awe on a spot which covered human beings, thus shut out from the world, and apparently cut off from all human aid. The colliers of the village, also, as evening advanced, were seen collected in groups, listening to the expression of each other's feelings, and devising plans for rescuing their fellow-workmen from their miserable situation. With the accuracy not uncommon to Scottish workmen, they considered the size of the rooms in which the miners might be supposed to have taken refuge, the quantity of air which these would contain, and the time it might support them; and the probability of their having any food. It was soon suggested that a little above the surface of the water, which had now ceased to rise, a shaft might be driven so as to reach these higher rooms in a certain time, namely, six or seven days. The execution of this plan, so promising and well conceived, was unfortunately delayed, from not unreasonable apprehensions of danger, from the closing in of the mine, and the explosion of the damp air; and there was but too much reason to fear that the unhappy objects of their pursuit would have perished before they could reach the spot. The men, too, were dejected and spiritless at the frightful fate of their companions. The work was not therefore begun till two days had elapsed, which, in calculating the probability of success, were to be added to the unfavourable side. At this time the workmen at the neighbouring pit of Auchlodmont offered their assistance to the Quarrelton colliers, and the mine was begun. Two men only could work at a time. They were taken from the two sets of colliers alternately; and, without intermission or abatement of exertion, they plied the work day and night. All eagerly looked to the period in which the mine was to be completed. Despair had begun to predominate, when, on the morning of the 12th, the glad tidings were heard that the shaft was finished, and that two of the men were alive. They were brothers, of the name of Hodgart, who had fondly clung to each other during the whole of their confinement. To add to the interesting scene of their deliverance, their father went down into the mine just before it was dug through, heard their voices, and was so overpowered that he had to be carried up,—happily removed from witnessing the difficulties which were yet to be encountered.

By this time, according to a narrative of the circumstances prepared by the colliers themselves, the damp or bad air had put out their lights; and as Bowie, one of the workmen, was advancing forward, the damp seized him, and he returned to get breath. Allan, another miner, immediately stripped off his coat and vest, and went forward in desperation, but was also obliged to return, and with difficulty escaped with his life, and had to be helped out to the fresh air, when he said he was sorry he had heard the voices of the imprisoned miners, for he feared that they would not be got out alive. By this time Peter Barr came to their assistance, and the two Hodgarts, creeping towards Patrick and Bowie, and the two latter rushing to meet them through the poisoned air, succeeded in laying hold of the hand of William Hodgart, and dragging him out, while his brother, who was left behind, cried with a lamentable voice for help. Barr, Patrick, and Bowie rushed forward again, and James Hodgart creeping to meet them, they succeeded in getting hold of him also, and drew him away. By this time it was about four o'clock in the morning, and after resting a little and breathing fresh air, the two brothers were asked how they had supported themselves. It appears that they had found a little oatmeal bread in a pocket, and on being questioned about the rest of the miners who had been enclosed with them, they said there were none in their company except Alexander Barr, and they supposed he was dead two days ago. They also stated that they had heard the engine going all the time, and had heard the men working at the shaft two or three days before they came to them.

Although every exertion was made to get out the other five, it was impossible to reach them until the water was drawn off. One of the bodies was found on the 28th of May, twenty-six days after the accident, and the others on the 3rd and 4th of June.

As soon as the brothers were restored to health, all were impatient to know how they had saved themselves from the water; how they had spent their time in the pit; what were their endeavours to escape; what their feelings; and what the conduct of those who, unlike them, had, alas! found in it a tomb. Some of these particulars were given by James Hodgart, one of the brothers. He stated as follows:—"On the 2nd of May, 1818, when I was at my work, I was, about eight in the morning, alarmed by the cries of the men that the waste was broken; I immediately ran to the mouth of the mine, but the water was running with such rapidity that I found it impossible to reach the bottom of the pit. I then saw the boy Shaw coming down the water. I pulled him out, and I then saw my brother, and helped him out. Then I saw Brydon, and gripped him, but I lost the grip. Then the other six were all together. Then I saw there was no help for us but to flee to the highest part of the pit. I was in great fear of being suffocated for want of air. I immediately ran to a biggin (a partition between one working, or pit, and another) that was connected with another pit, but found it had no effect; I built it up again. There we lay for some time, but we don't know how long. Then we thought to try the water again; and the water seemed for some time neither to rise nor fall, so that the run from the crush was still keeping the engine going; but on examining the place we found the water that stood so near us had been dammed in with sludge, for we heard the water running from us. Then we returned back to the men again, and we wished them to come along with us to try if we could reach the bottom of the pit. So we all came together to the place where the water was running; but the two old men did not cross the water; so the other four crossed it, but were obliged to turn back to the place we had left; and we lay there for a considerable time before we attempted it again, and all that we could get was a drink of cold water, which we carried in an oily can. Then we thought of trying the water again; and so we wished them all to come, but the old men said they would not, and wished the boy to stay with them, and he did so. We came away—Barr, my brother, and myself, and we got through the water with great difficulty. Then we got to the place where we heard the engine going, which continued night and day, and the sound of picks in the mine. Our clothes being very wet, we became very cold. Then we thought of searching for the men's clothes that had made their escape, which we found, and we found in the pockets some pieces of bread, but they were almost spoiled with the water and the dampness of the pit. There we lay for some time and heard the men working for us; so we went to a man's room and brought a pick, and *chapped* with it, but they did not hear us. We then turned weak and could not go (walk), so we lay there until the mine came through."

This narrative is deficient in the expression of such feelings as a situation so awful could not fail to awaken, but the words are those of an unlettered miner, and we can readily imagine, notwithstanding, with what intense eagerness the imprisoned men must have listened to the sounds made in attempting their liberation,—how they must have welcomed the first burst of light and the breath of fresh air that were to restore them, when life seemed almost ebbing away in darkness, starvation, and foul air. It is impossible for us to realize such sensations, but we may feel how great is the mercy of God, who in His mysterious dispensations watches over the helpless and the miserable, and when the last gleam of hope seems expiring, stretches forth His arm to help and defend them.

At *Irvine*, in Ayrshire, a calamitous event occurred in 1833. The neighbouring banks of the river Garnock were the seat of busy colliery operations until the mines became filled with water. The surface of the river was, at first, observed to be ruffled at a particular spot, in consequence of a chink having been formed in the bottom of the river, through which the water began to pour into the pits beneath. Immediately the whole of the men were got out of the pit, and the manager placed a coal barge, laden with such things as might stop the rush of the water, such as straw, clay, rubbish, &c.; but this was useless, for the water continued to pour into the mines with immense force. On the flowing of the tide the depth of the water between the chasm and the sea increased to about nine feet—then the desolation was awful! The long sweep and prodigious quantity of water rushing into the chasm at this time made the sight impressive beyond description. Three men who were in a boat near the spot had a very narrow escape from being sucked into the vortex, for no sooner had the men got out than the boat was drawn down with fearful rapidity.

The great body of water continued to pour down the chasm until the whole working of the pits, which extend for many miles, were completely filled; after which the river gradually assumed its natural appearance, and the water attained its ordinary level. At this time the pressure of water in the pits became so great, from the immense weight of water impelled into them, that the confined air, which had been forced back into the high workings, burst through the surface of the earth in a thousand places, and many acres of ground were to be seen all at once bubbling up like the boiling of a caldron. In some places the current was so impetuous as to form large cavities, and produced a roaring noise like the escape of steam from an overcharged boiler. Immense quantities of sand and water were thrown up like showers of rain during five hours, and, in a short time, several villages were laid under water, by which many hundred persons were thrown out of employment.

A fearful accident occurred in 1812 in a coal mine at

Liège, in Belgium. Just without the gate of that city, towards Brussels, several coal mines were wrought. There were three perpendicular shafts, at no great distance from each other, called Tréquenotte, Beaujonc, and Mamonster. The first two communicated with each other below ground, but there was no communication between the last two. In these mines, which were about 700 feet deep, the water was directed to a particular part of the mine, where it was confined by a wooden frame, from which it was raised to the surface by forcing-pumps. On the 28th of February, about eleven o'clock in the forenoon, the mine connected with that of Beaujonc was suddenly inundated by the breaking of the wooden frame I have mentioned of the mine Tréquenotte, the distance between each mine being 459 feet. At that time one hundred and twenty-seven workmen were in the mine, thirty-five of whom made their escape when the inundation took place. The overseer, named Goffin, with his son, was at the bottom of the shaft, and might have easily made his escape, but he decided upon remaining with the miners, to save or perish with them. He gave orders to Bertrand, Labeye, and Clavier, three miners who were sharers in his generous resolution, to go and warn their companions, and direct them to the part of the mine that was nearest to that of Mamonster. Meanwhile, he had assisted all the workmen who had collected at the foot of the shaft to make their escape. The danger at length became so great that these men did not hesitate to tear the boys by force from the ropes of the basket to which they had fixed themselves, and to take their places. But Goffin took up the poor boys and carried them along with him. By the time that thirty-five of the miners had made their escape the waters had risen to such a height as to cut off all communication with the shaft. Goffin collected all the miners in that part of the mine which he considered as nearest to Mamonster, and assisted by some of the stoutest among them, he undertook to open a passage into one of the galleries connected with that mine. They had a few candles, but no food. Though only two workmen could be employed at a time, they had already cut through twenty-three feet, when a violent explosion of inflammable air took place, by which they found that they had been penetrating, not into the galleries of Mamonster, but into some old workings of another mine. Some of the miners proposed to continue the work in the same direction, but Goffin prevented them, saying, "When we have no hope left I will conduct you to this place, and then all will be soon over."

At first the men refused to obey him, and gave themselves up to despair. The boys threw themselves on their knees to request a blessing from their parents, while the old men uttered dismal complaints, and lamented over the future lot of their wives and children. Goffin gradually inspired them with some courage, and persuaded them to proceed to the fifth gallery, where he thought they would be able to penetrate into the galleries of the Mamonster mine. But they were by this time so exhausted with their former labours, and by the want of food, that all the exertions of Goffin were scarcely sufficient to inspire them with any activity. Three times they threw down their tools in absolute despair; but sometimes by entreaties, and sometimes by threats, he always prevailed upon them to resume their pickaxes, and recommence their work. They had dug a gallery thirty-six feet in length, though by the second day their candles had gone out, and they were left in total darkness.

For the first two or three days they suffered dreadfully from hunger. Some devoured the candles they had contrived to conceal; others reckoned upon the speedy death of one of their companions as a means of furnishing them with food. Fortunately, nature dissipated, for a time at least, these scenes of horror, by giving them the refreshment of a sound sleep.

Meanwhile, everything had been done without the mine for the deliverance of the unfortunate miners thus buried alive, by the sagacious and vigorous orders of the prefect. The shaft of the Mamonster mine presented the only means of liberating them; but they had no exact plan of the workings, and knew not, therefore, through how much ground they had to penetrate in order to reach the galleries of Beaujonc mine. More than one hundred horses were kept constantly employed in pumping out the water, in order to prevent it from filling all the galleries. Twenty fresh men descended every four hours by the shaft of Mamonster mine, in order to relieve the workmen who were making a gallery towards Beaujonc mine. The engineer had ascertained the correct point from which the gallery must commence in order to reach the unfortunate sufferers. For greater certainty they employed blasting, until they were certain that they had been heard by the sufferers; then their zeal was redoubled, and the exertions made were incredible.

The noise made by the buried miners while endeavouring to penetrate to Mamonster became gradually louder and louder; and on the fifth day they were able to communicate with Goffin and his unfortunate companions. They were informed that they were *seventy-four* in number, that none of them had perished, but they were distressed by a dreadful heat, though sunk to the middle of their bodies in water. From that time the relieving party worked without lights in the mine of Mamonster, to prevent the inflammation of the air.

A communication was opened on the 3rd of March, four days after the accident, at seven in the evening, and every precaution was taken to prevent any fatal effects from the air or from fire. After having penetrated through a space of five hundred and eleven feet, a kind of detonation took place, from the escape of the condensed air, though happily without any serious result. The unfortunate miners were then released, and every possible care was taken to prevent any injury from too sudden an exposure to air and light. They were fed with a little wine and broth, then wrapped up in flannels, and laid for some time upon straw in the mine itself, before they were brought above-ground. Goffin, although the most exhausted of all, came out last with his son. This extraordinary boy had given proofs of the greatest coolness and courage. When the miners were in despair, and weeping bitterly in their dark and close prison, he called out to them, "Come along, you behave like children! follow the orders of my father. We must work, and show those who survive us that we retained our courage to the last moment of our lives."

CHAPTER X.

CURIOUS DISCOVERIES IN MINES.

It has often happened that in the course of excavations in search of minerals, the workmen have come upon some singular hollows or openings in the rock, caused by convulsions of the earth or earthquakes; or caverns through which torrents have flowed in former ages, and have left them for nature to ornament in the most beautiful and fantastic manner. You will understand how the natural caverns are formed that you may have seen on the sea-coast; the moving waters, carrying with them gravel and sand, enter the cracks and crevices in the rocks, and increase their size by wearing away portions of the rock until caverns are formed. Some of these are of immense size, and the extent of many are unknown, extending far beneath the earth, and leaving obstructions that prevent access. Many caverns are lined with beautiful crystals, called *calcareous spar*, or substances containing much lime, and generally coloured by the impurities of the water that has dropped on them. Sometimes these crystals are of a pure white, and have, when the cave is lighted up, a richness and transparency that can scarcely be imagined.

In sinking a shaft a short time ago, the Yorkshire Mining Company discovered, at the depth of about fifty feet from the surface, some remarkable caverns, thickly covered with *stalactites* (the name given to these crystal spars when suspended like icicles from the roof) and *stalagmites* (when they rise from the floor, and are caused by the evaporation of the larger drops which fall from above) of great splendour and brilliancy, and extending in a series of chambers, one over another, communicating with each other by small passages, in some places so narrow that a person has to squeeze himself through. Some of the cavities are as large as good-sized rooms, and are described as having the appearance of a palace of jewels, the rarity and beauty of which are beyond description. Others are long, narrow passages, or galleries. These subterranean grottoes are paved with crystals, having the appearance of stone, moss, and shells, in every variety of colour.

This description will remind you of the wonderful stories you have read about the fairies in *their* crystal palaces, and you will find that, after all the extraordinary powers they were said to have possessed, nature is the greatest fairy after all.

Caverns of enormous extent occur in Iceland; that of *Gurtshellir* being forty feet in height, fifty in breadth, and nearly a mile in length. It is situated in the *lava* (melted mineral substances) that has flowed from a volcano. Beautiful black volcanic stalactites hang from the high and spacious vault, and the sides are covered with glazed stripes, a thick covering of ice, clear as crystal, coating the floor. One spot in particular is mentioned by a traveller, when seen by torchlight, as surpassing anything that can be described. The roof and sides of the cave were decorated with the most superb icicles, crystallized in every possible form, many of which rivalled in minuteness the clearest froth or foam,—while from the icy floor arose pillars of the same substance, in all the curious and fantastic shapes that can be imagined, mocking the proudest specimens of art, and imitating many well-known objects of animated nature. A more brilliant scene, perhaps, never presented itself to the human eye.

In our own country, one of the most remarkable caverns is that called the *Peak*, in Castleton Dale, Derbyshire. The approach to it is in the highest degree magnificent. The traveller passes through a chasm between two ranges of upright rocks. A vast mass of rock suddenly appears before him with the mouth of the cavern, which is in the form of an arch, one hundred and twenty feet in width and forty-two in height. After proceeding about thirty yards, the roof becomes lower, and a narrow passage is reached, where daylight disappears, and torches are lighted. After penetrating twenty or thirty yards in a stooping posture, there is a spacious opening, beyond which is the margin of a small lake, called the "First Water," the overhanging rock descending in one place to within twenty inches of its surface. The lake is crossed in a boat, in which the passenger lies down, and is conveyed to the other side, where a spacious opening presents itself, two hundred and twenty feet in length, two hundred feet broad, and in some parts one hundred and twenty feet high. Proceeding onwards by the side of the "Second Water," there is a projecting pile of rocks called "Roger Rain's House," on account of the water incessantly dripping from the crevices of the roof. Beyond this another hollow opens, called the "Chancel," where the rocks appear much broken, and the sides are covered with crystals. Here the stranger is generally surprised by the sounds of a vocal concert from the upper regions of the cavern, where some women and children, who live in huts at the entrance, are stationed for the purpose.

After leaving the Chancel and passing the "Devil's Cellar," and the "Half-way House," the path leads through three natural arches to another vast cavern, termed "Great Tom of Lincoln," from its resemblance to a bell. Here, when lighted up, the scene is very remarkable.

A more extraordinary spot, perhaps, is in the neighbourhood, at the foot of the Winnats, a deep and narrow inclined chasm, about a mile in length. Here is the *Speedwell Mine*, an artificial excavation made in searching for lead, leading to a great natural cavern. After descending upwards of a hundred steps and reaching the level, the visitor embarks in a boat upon a channel so narrow as to be able to touch the rocks on both sides and the ceiling above. After proceeding nearly half a mile, the guide pushing along the boat, an immense chasm in the mountain is reached, and landing upon a ledge of rock, the scene becomes wonderfully strange and appalling when lighted up with a Bengal light. On the one hand there is an abyss of unknown depth, appropriately called the "Bottomless Pit," into which the water falls from the level with a startling sound, and which swallowed up forty thousand tons of material in the excavation of the mine. On the other hand an enormous cavity opens above, the ceiling of which no light can reach, for rockets have been fired off, and have given out their brilliant sparks as freely as from the surface of the earth.

In this neighbourhood is the *Old Tor Mine*, out of which many a splendid piece of spar has been obtained, also the "Tre Cliff," or "Blue John Mine," one of the largest natural, as well as artificial, excavations in Derbyshire. In this mine is found the beautiful mineral called *fluor*, or, more commonly, "Derbyshire spar," a composition of lime and acid, found in small detached pieces in the limestone rock. Rude steps, leading downwards about sixty yards, lead to a series of caverns and passages encrusted with stalactites. It is well that I should explain to you that this term comes from a Greek word signifying "distillation" or "dropping," as they are formed from water trickling through the roofs containing carbonate of lime, held in solution by carbonic acid. Upon exposure to the air the carbonic acid is gradually disengaged, and a small portion of lime is left. The process proceeds, drop after drop, and, at last, points, like icicles hanging from the roof, are formed.

In this mine an extraordinary effect is produced by the stalactites, in one cavern, having grown downwards until they rested upon some shelf of earthy matters, and in the course of time wonderful fairy columns have been formed of remarkable beauty, called the "Organ.' The principal subterranean apartment of the Blue John mine is called the "Hall," and from hence passages stretch out to an extent unknown. It is said that the late Marquis of Normanby, when Earl of Mulgrave, explored this mine for three days, accompanied by guides, without finding any termination.

Some labourers in working for ochre, which is found in fissures of the limestone in the Mendip Hills, laid open a series of caverns near the village of *Hutton.* In the first chamber, about twenty feet square and four high, a large stalactite hangs from the roof in the centre; and beneath a stalagmite, formed by the droppings from above, rises from the floor, nearly touching it. The bones of elephants and other animals were found here, and as this subject is deeply interesting, I may explain to you that places where similar remains have been found, are called "zoolithes," or bone-caverns. These are found in almost every country of Europe and also of America, and are highly important, because of the light they throw upon the ancient condition of the earth, and the changes it has undergone; many being the remains of extinct animals that thousands of years ago lived in our own country. I cannot enter into more particulars on this subject, as it opens a wide field of inquiry; I have merely mentioned it to show what wonderful objects the miner sometimes meets with in his researches under ground. In sinking for a lead mine in 1633, near *Wirksworth*, the miners came to an open place as large as a church, and found a skeleton reclining against the side, so large that they could not get it up without breaking it. A cavern called *Dream Cave*, near Wirksworth, was discovered by the miners in digging for lead. It was found at about the depth of sixty feet, and contained the remains of a rhinoceros in a high state of preservation. Some miners found a cave in *Crawley Rocks*, near Swansea, which contained bones of elephants, the rhinoceros, hyenas, and other animals. Numerous other caverns have been discovered with similar remains. In the Hartz mountains, in Germany, there is a cavern called *Bauman's Hole*, from an unfortunate miner who, in 1670, ventured into it alone in search of ore, and after having wandered three days and nights in solitude and darkness, at length found his way out, but in such a state of exhaustion that he died almost immediately.

If you should happen to be in the great manufacturing town of Birmingham, you would enjoy a visit to the famous *Dudley Castle Mines*, about eight miles distant in Worcestershire. Here are iron and coal mines, and limestone quarries, and immense caverns of singular appearance have been formed in the mining operations. In the lower part of the Castle grounds is the descent to one of these hollows by a few rugged steps leading to a wondrous avenue of rock-works, displaying a wild and singular appearance.

It has frequently happened that miners have discovered curious traces of former workings, hundreds of years ago, and tools have been found which belonged to the ancient miners, and many other relics. A singular discovery was made, a few years since, by some workmen engaged in the Spanish silver mine known as the *White Pebble Pit.* Whilst digging their subterranean passages they suddenly found a series of apartments, in which were a quantity of mining tools, left there from a very remote period, but still in such good preservation that there were hatchets, and sieves for sifting the ore, a smelting furnace, and two anvils, which proved that the earliest miners had great experience in their operations. In one of the caverns there was a round building, with niches, in which were three statues, one sitting down, and half the size of life; the other two were in a standing position, and about three feet in height. This building is supposed to have been the temple of the god who was believed, in pagan times, to preside over mines. Several objects of art, and some remarkable instruments, were also found, which have led scientific persons to think that the workings might have been made by the Phœnicians, the people who, as I have before stated, in the time of Solomon, were famous for their manufacturing and commercial genius.

In 1854 a discovery was also made by some miners excavating on the other side of the mountain on which the White Pebble Pit is situated; this was a fine figure of the heathen god Hercules, which was found in an old working.

In digging for copper lately on the banks of *Lake Superior*, in America, the miners came to some openings made ages before, and found several stone hammers of rude workmanship, round at one end, and pointed at the other. A mass of native copper was found weighing six tons, collected together, and placed on beams of oak, which had crumbled into dust with age. The copper had evidently been abandoned as too laborious to be moved. They had taken off every projecting point which was accessible. Upon one of the mounds of earth thrown out from an excavation the stump of a pine tree was observed, which must have grown, flourished, and died since the mound was raised. The hammers found exceeded ten cart-loads full, many of them broken, which appeared to have been discarded by the ancient workmen. A period of at least five hundred years is assigned to these relics, but they are probably of much older date, for an almost impenetrable forest stands on the spot of these excavations. In Cornwall, relics of the old mines have been frequently found. It is curious that a shovel, found about ten years ago, was in shape precisely similar to that now in use, and this may have been employed in times when the Druids probably occupied the place of priests, and the hills were clothed with forests, long since disappeared, and probably used for smelting the tin that the valleys yielded.

A clever scientific Frenchman, M. Caillaud, to whom the discovery of the famous emerald mines of *Mount Zebarah*, in Egypt, is due, has described his entrance into these subterranean excavations, which had remained unexplored for ages. The emerald is one of the most beautiful stones presented to us by nature; its fine velvety, green appearance is particularly attractive and highly prized. M. Caillaud found these mines in nearly the same state as they had been left by the miners of the Ptolemies, rulers of Egypt before the birth of our Saviour. There were a multitude of excavations and subterranean canals, carried to a great depth, and admitting of four hundred men being employed therein. Extensive causeways and other important works show on what an immense scale these mines had been worked. The ropes, baskets, levers, grinding-stones, vases, lamps, and other tools and utensils, were still lying around, as though the miners, over whose ashes so many centuries had passed, had left them but yesterday.

You will, no doubt, be surprised that these mines should have remained so long unopened, especially when I tell you that ancient writers had alluded to them, and the Arabs, inhabitants of the country, had some confused notion of them. But these people were deterred from any examination of the locality by superstitious fears. They consider the caves where the excavations had been made the abode of snakes, wolves, and other beasts of prey; and, more fearful than this, the haunts of demons, who would instantly kill all intruders. The night previous to M. Caillaud's entrance into the excavations the Arabs spent in firing off their guns, to frighten away the evil spirits. We will now give M. Caillaud's report:—

"Having reached these caves I knew them at once to be mines, but what kind I could not tell. I set three Arabs to clear the entrance to one of the excavations. As I was resting from the fatigues undergone during that day and the preceding ones, my eyes chanced to light on a fragment of emerald, of a dark green colour. My surprise and delight were great. Forgetting all fatigue, in my impatience to visit the level, I encouraged the men, and began to work with them. We soon gained an entrance into the mine. I immediately caused torches to be lighted, and, accompanied by my interpreter and a workman, I descended by a very oblique road. I had scarcely gone a hundred paces when I found the too rapid inclination of the lode rendered the road dangerous. The frightened Arab turned back; my interpreter, finding the way too narrow, hesitated and stopped short; I alone continued to descend for the space of three quarters of an hour. I then found the road choked and blocked up by enormous masses of mica, which had fallen in from the top. I was alone to clear the way, four hundred feet under ground, through many difficult and even dangerous passages. My strength would not permit me to remove the obstacles, and I was obliged to give up my attempt to proceed further. I was about to reascend, disappointed at my having made no discovery, when amidst the masses of rubbish I perceived an emerald prism. I detached it carefully, and then wandered some two hours longer in these narrow levels, during which time my interpreter began to be alarmed for my safety; the great depth I had reached quite prevented me from hearing his repeated calls. He sent for a rope and let it down into the shaft, thinking it might reach, and be of assistance to me on my return. My light beginning to burn dimly, after resting awhile, I again sought the upper road, the ascent of which I found very laborious. Amidst the profound silence that reigned around me, the voice of my interpreter at length reached my ears, and guided me to the spot where he stood. His first question was, 'Had I found any emeralds?' I replied in the negative, but in such a tone that he was fully persuaded I had my pockets full. This thought was a greater punishment to him than any reproaches of mine."

The following day M. Caillaud found more than forty excavations similar to the one described. These mines, abandoned many ages, are mostly filled in by the falling in of portions of the mountain, and by the stones brought by the torrents. It was in his second expedition in the following year that M. Caillaud ascertained that some of the excavations had been carried to a depth of eight hundred feet below the surface of the ground, and some of them were so spacious that four hundred men could work there at once. Seven leagues from Mount Zebarah he found mountains containing much larger emerald quarries; and some in which there were more than a thousand excavations, furnishing a means of communication between the upper and the lower ground workmen on an extensive scale; there were stone causeways along which the camels could convey provisions to the farthest extremity of the mines. About half a league from these quarries M. Caillaud found a Greek tower and five hundred huts still standing in very good condition, though probably they had not been inhabited *for two thousand years.* These were, no doubt, the houses of the ancient miners. These workmen (observes M. Caillaud) appear to have cared little about facilitating the labour of their mines, as these would now be looked upon as impenetrable. The miners were obliged to creep or slide, sometimes on hands and feet, sometimes on their backs or quite flat on their chests, through little narrow paths running in all sorts of oblique directions. M. Caillaud brought back to the Pacha of Egypt about ten pounds weight of emeralds, taken from the mines of Mount Zebarah.

In the neighbourhood of *Alston Moor*, a famous lead-mining district in Cumberland, is the curious limestone cavern of *Ale Burn*, which is intersected by a vein of lead. The following notes descriptive of this singular place were made during a subterraneous survey of its dark and gloomy chambers:—"After climbing from the level roof by an opening barely sufficient to admit our passage, we ascended (what the miners call) a *rise* of about thirty feet in height by means of sticks placed alternately at two opposite sides of the rise. On gaining the top we entered with some difficulty into a small circular opening in the limestone, just large enough to permit our creeping along it on hands and knees. On proceeding a few fathoms in this uncomfortable posture, the noise of rushing waters was heard increasing until it became very loud, and we soon found ourselves near the spacious summit of a vault or natural cavern, twenty-three feet high, thirteen feet wide, and sixteen feet long. We climbed down the nearly perpendicular side to a stream of water which passes the whole length of the cavern, and at this time containing as much water as Ale Burn. This rivulet seems partly fed by the springs of Ale Burn, and in rains is much increased by the surface water poured into it by means of numerous swallow-holes. Having descended, we turned past a projecting screen of rock, and from thence gained access to the continuation of the cavern westward. Here the natural curiosities which present themselves, if they do not deserve the very lavish expressions of surprise and admiration often bestowed on similar scenes, at least deserve this, that they well repay the difficulty experienced in visiting them, and which, to persons unaccustomed to mining excursions, is by no means inconsiderable. It must be kept in mind that this is merely a limestone cavern, which, although exceedingly curious as such, is not possessed of the varied and splendid attractions of some celebrated caverns. Its dimensions vary considerably, being in some places from twenty to thirty feet high, and in others it is nearly filled with large loose blocks of limestone, the passages through the interstices of which are both difficult and dangerous. The sides present a curiously fretted surface, moulded by the long-continued action of water into a variety of singular forms, some of which are truly remarkable. It is curious to observe the process of this slow but constant operation, for the water, gradually wearing the channel by which it first enters the cavern, falls successively on different portions of the rock below, until in the course of years the whole of the sides of the cavern have been subjected to this fantastic chisel of nature. Many of these grotesque forms, especially when dimly seen, need little aid from the imagination to represent the images of various animals and other objects. In one place we observed an almost exact profile of the human face. The idea of the head and neck of foxes and eagles was often suggested by projecting pieces of rock; and in a small cavern, branching from the main one, four or five singularly shaped pieces of limestone seemed like a consultation of various animals suddenly changed to stone.

After proceeding upwards of a hundred yards along the cavern we saw a vein of lead ore which intersected it, and from which some of our party worked a few specimens. From this place westward the cavern becomes much straiter, so that in some places where the roof had fallen we could only proceed by lying on our breasts and getting forward through the narrow chasm as well as we could. At length the stream of water entered a very low and narrow passage, into which we waded on our hands and knees until nearly all our lights were lost, so that we were compelled to return. On retracing our steps to where we first entered the cavern, we proceeded along the first chamber, and by a low passage entered a second, at the east end of which is a double entrance to a third cavern, divided by a curious natural pillar about thirteen feet high. A waterfall at the west end of this cavern presents a fine spectacle. Above it, huge masses of limestone are lying about in magnificent ruin, which, with the echo of the falling stream, excite sensations in which terror and sublimity are strongly blended."

In the lead mine of *Hudgill Burn*, in Cumberland, a cavern was discovered in 1816 by some miners in the limestone rocks. It is thus described by a party of travellers:—"Advancing about halfway in the cavern we came to a thin rock which divided our passage into two. We pursued the right-hand passage, now become so narrow that a bulky man could scarcely get through. As we passed along, several openings and small recesses on our right and left were seen, but not of a sort to excite much interest until we reached the far end of this passage, where there is an open space equal to a room of ordinary size, nearly square, lined with smooth jet-black walls, richly spangled with stalactites that sparkle like brilliants of the first water. The solemn grandeur of this place inclined us all to pause and contemplate the sublimity of the novel scene around us. The substance of so jet a black with which this charming little cabin is lined is called by miners 'black-jack.' It contains a portion of the ore of zinc, and is smelted for its valuable produce, being in great demand for potteries, medical purposes, brass, &c. In this beautiful little room there are two openings, in form nearly square, lined with the same substance, and embellished with glittering spar of exquisite brilliancy. These transparent particles are very regularly distributed over the walls, neither too thick nor too thin to give the effect of genuine taste and finish; but the process of nature is going on, and that brilliant spar will most probably become a thick crust if not impeded by the hand of the workman, and will in time become a solid mass of quartz, of which numerous large pieces are found in this mine."

CHAPTER XI.

MINES UNDER THE SEA.

"What hidest thou in thy treasure-caves and cells,
Thou hollow-sounding and mysterious main?
Pale, glistening pearls, and rainbow-coloured shells,
Bright things which gleam unrecked of and in vain."

MORE curious still than the *inland* mines we have described are those which are *submarine*, or *worked under the sea*. You will wonder that men can work in dark caverns under the rolling ocean, but such is the fact; and a very large amount of mineral riches has been extracted from the rocks, over which storms are careering, and the waves dashing with the utmost fury. I think that you would be frightened to descend into one of these mines, even in calm weather, and hearing the stones rattling over your head at the bottom of the sea, which is only separated from you by large rocks, through which, if the water penetrated by any incautious boring of the miner, certain death would be the result. Yet in these fearful places the miner works without the least dread. You would, no doubt, suppose that some water would gain admission into these mines; but it seems singular that the deeper a mine is worked under the sea, the drier it becomes.

The *St. Just* Cornish mining district, situated in the extreme west, on the borders of the Atlantic Ocean, has been long celebrated for the peculiar position of its mines, situated among perpendicular rocks, and excavated thousands of feet under the level of the sea. In length this district stretches nearly five miles, north and south, along the coast. The best known mine is *Botallack*, which extends upwards of three thousand feet below the level of the sea. What is called the CROWNS is the most remarkable mine, and has been worked by two shafts, both on the edges of the cliffs, and the excavations have extended upwards of half a mile out to sea, which distance has been gradually increasing, in consequence of the ore dipping rapidly away sea-wards. The late workings in the mine have been attended with serious inconveniences, one of the chief arising from a want of ventilation, in consequence of the impossibility of communicating with the surface for such a great distance. About twelve hundred feet from the Crowns mine is the COCK (now part of Botallack mine), which is very ancient, and was a very productive copper mine. The rocks under the sea have been worked away so close in some places, that only a few inches of ground remain to keep out the waters of the Atlantic. Even in the finest weather, the rolling of the pebbles, with the swell of the ocean, can be heard with greater distinctness than on the beach itself; and during great storms the noise is so appalling that, although certain of the absence of real danger, the workmen are often anxious. At one place in this mine, when a workman was boring a hole, the sea penetrated, but fortunately the ground was very hard, and the opening was not considerably increased before the hole was plugged up with the handle of a pick.

A writer who was once underground in this mine during a storm says, "At the extremity of the mine workings little could be heard of its effects except at intervals, when the reflux of some unusually large wave projected a pebble outwards, bounding and rolling over the rocky bottom ; but when standing beneath the base of the cliff, and in that part of the mine where but nine feet of rock stood between us and the ocean, the heavy roll of the large boulders, the ceaseless grinding of the pebbles, the fierce thundering of the billows, with the crackling and boiling as they rebounded, placed a tempest, in its most appalling form, too vividly before me to be ever forgotten. More than once, doubting the protection of our rocky shield, we retreated in affright, and it was only after repeated trials that we had confidence to pursue our investigations."

In the LEVANT mine, in 1866, at a comparatively shallow level, far out under the sea, a great outcry was raised by the miners that the sea water was coming in to their very great danger, and threatened the destruction of the mine. The captain, or manager, had to look closely into the matter to find out the real state of the case, and proved beyond doubt that there was a considerable quantity of salt water penetrating into the mine, but as this was from an old and well-known place, there was no reason to entertain fears of immediate danger. The truth was, that the tin ore in that quarter being very good, but surrounded with hard and difficult rock, the miners had been allowed to work upwards towards where there might be risk, and had penetrated the thin crust that kept out the sea. It was, of course, determined to leave off working in this perilous part, which was also strongly timbered and strengthened. Nothing could be more appalling than the entrance of the sea into the deep workings.

During the visit of the Prince and Princess of Wales to Penzance, in July, 1865, their Royal Highnesses expressed a wish to visit the Botallack mine, and preparations were made accordingly. At no point of the route from the town was the road-side untenanted for more than a few hundred yards, while every small hamlet had its flags flying, and many their triumphal arches besides. When the royal procession had reached some four or five miles from Penzance, the scenery began to undergo a complete change, but not so the warmth of the welcome which the Prince and Princess received. That continued to be as hearty as ever, although there was no longer any foliage to set off the efforts of those by whom it was rendered. The mining population near St. Just have no trees mingling their branches across their roadways, or approaching so close to one another that wreaths or flags could be suspended between them, as was several times the case near Penzance. But the miners have good lungs and loyal hearts, and they did not fail to make a good display of both. In the village of St. Just itself, which is situated about seven miles from Penzance, and which commands a fine view of the British Channel, neither flags nor triumphal arches were wanting, nor children, nor cheers. All about it the land is barren, and it gradually grows wilder and more barren towards the cliffs of Botallack, which are about two miles further on. These cliffs, which are lofty and irregular, jut boldly into the sea. At the foot of one of them, or nearly so, is the entrance into the Botallack mine. Some way into the cliff is the *count-house*, a tolerably spacious building, in which money matters and other business connected with the mine are transacted, and here it was that the Prince and Princess for the first time alighted. The front of the house was of course decorated with evergreens twined into arches. Here some time was occupied by the royal party in changing their dresses, with a view to visiting the interior of the mine. After a lapse of about half an hour the Princess came out dressed in a fine white flannel cloak, which completely enveloped her, and which was trimmed at the neck with blue ribbon. A white straw hat, having also a band of blue ribbon, completed her costume. The Duchess of Sutherland, Lady Vivian, Lady De Grey, Lady E. St. Aubyn, and Lady Audrey Townshend wore similar dresses. The Prince, the Duke of Sutherland, the Duke of St. Albans, and the other noblemen and gentlemen of the party, had on white flannel frock coats, white trousers, and low white hats. At the door of the count-house the Princess and the Duchess of Sutherland took their seats in a small donkey-carriage, and were drawn very gently down the rugged path which led to the cliff. The rest of the party walked behind them. When they came to the wooden platform, which leads from the heights to the entrance of the mine, at the base of the opposite cliff, the Princess and the Duchess of Sutherland alighted, and having descended a little further down by means of the artificial aids, in the shape of timber structures, employed all around, they could see below the doorway leading to the subterranean recesses which they were about to visit. The platform on which they then stood, a narrow way constructed of timber, and looking very much like a miniature railway, ran down to the entrance of the mine, and thence on deep into the recesses of the earth. On this way a low car, covered with crimson cloth fringed with orange, was placed, with grooves, not wheels, to fit the rails. To the back of the car a stout metallic rope, which could be let out or drawn up at pleasure, by means of machinery higher up the cliff, was attached. The Prince and Princess, together with the Countess De Grey, and Mr. and Lady Elizabeth St. Aubyn, having taken their seats in this car, the rope was gradually let go, and they glided gently down the shaft through the doorway, each of the party being provided with a lighted candle, to a depth of more than twelve hundred feet beneath the sea, under which the mine extends for a distance of half a mile. When the Prince and Princess had got to the bottom, the car was pulled up by means of the rope, and the Duke and Duchess of Sutherland, and other members of the royal party, descended into the mine, the process being repeated until the whole party got to the bottom. While all this was taking place, every ledge of rock on the vast heights above, on which a human being could find a footing, was crowded by hundreds of people, young and old, some of them in positions apparently so dangerous that on the slightest movement they would tumble down headlong. Botallack mine has long been famous for its tin and copper ore, the latter being found chiefly under the sea, and the former inland. The Prince and Princess spent about an hour in examining the dark and rugged passages of the mine, over which they were conducted by men acquainted with the workings. Their Royal Highnesses, when they returned to the light of day, again got a tremendous cheer from the cliffs all around, and expressed themselves much pleased with all they had seen. They then climbed up the ascent to the count-house, where their mining dresses were changed for ordinary costume, and where they partook of luncheon, afterwards returning to Penzance.

Another royal visit to a mine under the sea, which occurred about two hundred and fifty years ago, was not quite so auspicious. The collieries of CULROSS, in Scotland, were at one time the most extensive in that country, and what is remarkable, they extended a considerable way beneath the Firth of Forth. It is recorded that when James the Sixth revisited Scotland, after his accession to the throne of England, he made an excursion into Fife for the purpose of enjoying the diversion of hunting. After recreating himself with the sport, he invited his attendants to dine with him at a "collier's house," meaning the Abbey of Culross, then belonging to Sir George Bruce, one of the most ingenious and enterprising coal-masters in Scotland. Being conducted, at his own desire, to see the works underground, of which he had heard a good deal, he was led by a passage to the mouth of a pit opening within sea-mark, and only protected from inundation by a wall or moat. Having ascended to the brink of the opening, he was astonished and dismayed to find himself, without previous intimation, surrounded by water; on which he was seized with terror, fearing some plot against his liberty or life, and called out, "Treason! treason!"

But Sir George assured him there was none, and that he had nothing to fear. Pointing to a pinnace that was made fast to the wall, he desired to know whether his Majesty would feel it most agreeable to be carried ashore in it, or to return by the subterraneous route. The king preferred the shortest way back, and was borne ashore in the vessel, expressing his admiration of what he had seen. After this the royal guest was sumptuously entertained at the abbey. Some of the glasses are still preserved in the family of his host, and the room in which he was feasted is called the King's Room. It is stated that this curious pit was totally destroyed in 1625, on the night of King James's death, by a violent storm, which, washing away the raised part around the wall, deluged the mine with water and entirely choked it. The stones of the rampart that were not carried away were afterwards used for repairing the stone pier at Leith.

The most singular of submarine mines was one called the WHERRY mine, executed more than a century ago in the midst of the sea, near the pier of Penzance, in Cornwall. At low water in this place, a gravelly bottom was laid bare, in which was discovered a multitude of small veins of tin-ore, which crossed each other in every direction. The adjacent rock also contained the mineral in considerable quantities; this rock was worked whenever the sea, the time, and the season would permit, until the depth became too great.

The place where this submarine tin-ore was found was about two hundred yards from the shore; and as the bank of the sea in this place is very steep and high, this distance is considerable, even at low water; and at high water is covered by the sea six yards deep. As the bottom is gravelly and full of rocks, the waves become much agitated, and rise to a great height when the wind blows from particular points. This inconvenience takes place throughout the winter, and had always led to the failure of the different attempts which had been made before to drain the mine and to raise the ore. At low water the rock rises a little above the surface of the sea; nevertheless, there are not ten months in the year in which it is uncovered.

You will see from this description how almost impossible it would seem to have worked in such a mine, under apparently insurmountable difficulties; yet, in 1778, a single individual, who possessed only a few shillings to start with, determined to make a trial, and how well he succeeded you will learn. This courageous miner, named Thomas Curtis, employed three summers in sinking a pit or shaft, during which time he could only work two hours daily, owing to the tide; and every time when he went to work he found the space he had dug filled with water. This he was obliged to empty out before he could recommence working, which occasioned still greater difficulties when he set about blasting the rock. At first he had only need of strength and patience; but when he dug to a greater depth he added to them ingenuity. He built around the mouth of the pit a turret of wood, to protect it from the water, and by this means was able to prolong the time of working on the rock. He further endeavoured to shut out the water entirely from the pit, by raising the turret above the greatest height to which the sea could reach.

But here he had new difficulties to conquer: first, to make this turret impervious to water; and secondly, to stay it in such a manner that neither the flux or reflux of the sea, nor the shocks of the waves, could overcome it.

The enterprising miner had provided against them. The rock was fortunately of porphyry, not too hard to cut, but still very firm. He shaped the pieces he separated from it, and disposed them in a regular manner at the bottom of the turret, and closed and caulked with oakum and fat cement all the openings between the wood and the stone, so that the whole was united into one mass. The shaft, or pit, like most of those in Cornwall, was lined with planks, all the joints being well caulked and pitched. When his framework was thus constructed he supported it with iron braces. About the mouth of the pit he raised, upon four great piles, a platform of planks to support the winding machine, which was worked by four men. This work, as may be imagined, took much time, and met with many mishaps in the execution; but the courage and perseverance of the industrious miner overcame all obstacles. When the pit and tower were finished he then reaped the fruit of his work, and drew from the mine, in a short time, a considerable amount of tin. He was now enabled to pursue his search with better means and assistance. There were times, however, when the undertaking was not in such a good state; so to save expense and diminish his labours he attacked the part of the mine overhead, by which means, at high water, the sea penetrated through the chinks of the rock, so that he was obliged to sustain the roof, which was pretty extensive in some parts, by planks and thick props, to prevent the great mass of water which pressed on it above from driving it in. Besides this, notwithstanding all his endeavours, it was not possible for him to keep his wood-work water-tight in the winter; and when the sea was rough he could not transport the ore ashore in his boat. In the autumn of 1790, the chamber excavated in the inside of the rock measured in depth thirty-six feet, and in length about eighteen feet. Four men in two hours emptied the pit of water, by the windlass, at the rate of four tons each minute, towards the end of which time six men drove it from the bottom of the pit, and poured it into the passage. After drawing off the water they worked six hours more on the rock. From one tide to another they raised about thirty sacks of ore, each sack containing fourteen gallons, and the value of the tin obtained in the course of six months amounted to six hundred pounds.

As most of the ore was mixed with hard rock, difficult to pound, the miner had it roasted in a common lime-kiln, which answered the purpose very well.

The persevering miner who had accomplished this triumph over apparently insurmountable obstacles died at the age of seventy years, in the winter of 1791, the mine having in the preceding summer yielded tin worth three thousand pounds.

The expenses of excavating deeper into this singular mine, and the difficulties attending the operations of the miners, the water dripping continually through the roof, and the roar of the waves above being sometimes awful and daunting the boldest miners, at length the works were abandoned. A vessel in a storm was once driven against the upper platform, and carried away a portion of it.

At WHITEHAVEN, in Cumberland, the coal mines extend from two to three miles under the sea. Sir John Lowther, in the time of Charles II., obtained a grant of the lands between high and low water marks, and built a pier, within which a hundred vessels could shelter; the neighbouring hills were pierced, and made to give up their thick seams of coal. At first a few straight galleries sufficed in these mines, but it became necessary at length to pierce beneath the bed of the sea, and now there are hundreds of miners hewing and blasting, day after day, at a depth of from seven hundred feet to twelve hundred feet, while the waves roll and ships sail above their heads.

Two instances are recorded in ancient history of mines wrought in or under the bottom of the sea. One of these is mentioned by Pausanias, who, speaking of the temple at Delphi, observes, "Near the votive offering of the Tarentines is the treasury of the Siphnians. It was built upon the following occasion. Their isle produced mines of gold. Apollo commanded them to dedicate a tenth part of their produce to the temple at Delphi. They built a treasury, and remitted a tenth, but when through avarice they neglected to do this, the inundations of the sea destroyed the mines and caused them to disappear." There is nothing in this story but what may be accounted for by natural causes. The mines were at first very productive; they were worked by degrees to a greater depth, and with less profit; at length, when the Siphnians were tempted to pursue the veins under the sea, the waters broke through the thin partition, and put an end to the operations of the miners.

A second mention of submarine mines is by Aristotle (born three hundred and eighty-four years before Christ), and vestiges of these workings have been discovered on a small island near the shore of Chalcedon, in Asia Minor.

CHAPTER XII.

IRON AND ITS USES.

I WILL now direct your attention to one of the most valuable metals that we possess, IRON, which, by the Providence of a bountiful Creator, is plentifully distributed throughout nature, pervading almost everything, and is the chief cause of colour to earth and stone. This wonderful metal enters into almost all the substances with which we are acquainted, as well vegetable as animal. It circulates in your blood, it pervades the juices of vegetables, and is found in all the minerals, earth, and stones within the reach of chemical examination. To the magnetic qualities of iron we owe the *mariner's compass*, by which men are able to traverse the ocean, and to steer their course to any particular country with the utmost accuracy and certainty. The *uses of iron* are manifold; it is capable of being cast into moulds of any form, of being drawn out into wires of any strength or fineness, of being extended into plates and sheets, of being bent in any direction, of being sharpened, hardened, and softened at will. Iron furnishes the sword and the ploughshare, the scythe, the pruning-hook, the needle, the graver, the spring of a watch or a carriage, the chisel, the chain, the anchor, the cannon, and the bomb. It is a medicine of much virtue, and the only metal friendly to the human frame. The application of iron to building purposes has been seen in the erection of the Crystal Palaces at Hyde Park and at Sydenham. The prodigious iron ships also, that have been among the most wonderful productions of art in modern times, show how extensive is the use of this metal. For railways the iron now required is enormous; then, if we think of the thousands of miles of pipes that are required for water and gas, bridges, pillars, railings and balconies, culinary vessels, machinery of every kind, nails and screws in countless myriads, tools for every kind of handicraft, cutlery, and an immense number of other objects, we are lost in amazement at the value and importance of this greatest boon to man. Iron affords in the mineral kingdom, as flax does in the vegetable, a striking example of the increased value given to the raw material by the labour and ingenuity of man. Thus a few penny-worth of flax may be wrought into a veil of Brussels lace worth many sovereigns, and one pound weight of iron, of the value of a halfpenny, being converted into steel, may be made into seventy thousand watch-springs, which would be worth a very large sum of money.

Iron appears to have been known and used by the in habitants of the world in the earliest ages, being frequently mentioned in the Holy Scriptures. If you refer to the fourth chapter of Genesis, you will find that Tubal-cain is alluded to as the instructor of every artificer or workman in brass and *iron.* Moses also mentions furnaces of iron and of the ores from which it was extracted, and tells us that swords, axes, knives, and instruments for cutting stones were, in his time, made of this metal.

The smith, or worker in iron, Mr. Smiles tells us, was considered an important personage in former times, and amongst the Anglo-Saxons he was treated as an officer of the highest rank. In the royal court of Wales he sat in the great hall, with the king and queen, next to the domestic chaplain, and he was entitled to a draught of every kind of liquor that was brought into the hall. His duties were, however, multifarious, for trades and manufactures were not divided as they afterwards became. Besides making nails and horse-shoes, and tools of various kinds, he employed his handicraft on all sorts of warlike weapons, and forged the mail coats and armour for the knights and their horses.

In course of time the smiths of particular districts began to distinguish themselves for their excellence in particular branches of ironwork. Thus the makers of swords, tools, bits, and nails, established themselves at Birmingham, and the makers of knives and arrow-heads at Sheffield. The value and importance of iron may be conceived when we find that in Edward III.'s reign, the pots, spits, and frying-pans of the royal kitchen were classed among the king's jewels.

In Scotland the smith was also highly considered in the Middle Ages, and a story is told of one of this craft having committed a crime, for which he was found guilty and sentenced to death; but the chief could not dispense with his services, and so offered to hang two weavers in his stead.

It was the knowledge of iron-forging which laid the foundation of the once great empire of the Turks. Gibbon relates that these people were originally slaves of a powerful khan, or chief, and dwelt in certain districts of a mountain ridge in the centre of Asia, which produced large quantities of iron. This metal the Turks forged into warlike weapons for the khan, but at length a bold leader arose amongst them, who persuaded the iron-workers that the arms which they forged for their masters might, in their own hands, become the instruments of their freedom. Sallying forth from their mountains they set up their standard, and they soon freed themselves. For hundreds of years afterwards the Turkish nation continued to celebrate the event of their liberation by an annual ceremony, in which a piece of iron was heated in the fire, and a smith's hammer was successively handled by the prince and his nobles.

The iron mines of England were well known to the Romans (who, you will remember, invaded England under their leader Julius Cæsar, fifty-five years before the birth of Christ), but iron was one of the last of the metals to come into general use, which is partly accounted for by the fact that iron, although so generally diffused, is never found in a native or pure state except in *meteorites* (which I will explain hereafter), and that to recognise its ores, and then separate the metal from the earth or clay in which it is found, requires a considerable amount of observation and invention.

If you were to see a lump of ironstone you would not be able to discover any affinity from it, as brought up in a rough state from the mine, and the iron or steel that is converted into so many different objects. The ore is of a light, livid grey colour, and is found most frequently intermixed with fossil productions, and is extracted from the same pits by which the coals are raised to the surface, either embedded in the clay found in the vicinity of the seams of coal, or forming distinct beds alternating with those from which the coal itself is obtained. The facilities thus afforded to the iron manufacturer, by the presence in the same locality of the ores and the fuel required for their reduction, are the chief causes of the superiority of the iron-works of Great Britain, and of the low price at which that metal is produced. The principal places where iron is obtained in

Great Britain are those of Dudley and South Wales, Lanarkshire and Ayrshire in Scotland. All coal-fields, however, do not produce iron ore. The Newcastle district, which is perhaps the richest coal-field in the world, yields so little iron that the furnaces which are worked in that neighbourhood are principally supplied by ores brought from a considerable distance by sea. Swedish and Russian iron have long been held in great estimation, on account of their being smelted by charcoal furnaces. Pitcoal is obliged to be used for that purpose in our country, owing to the scarcity of wood. Notwithstanding this, the best English iron is very little inferior to foreign. Welsh iron is considered stronger than that made from Scotch ore.

To explain the necessity of smelting the iron ore, I should inform you that ironstone is a combination of that metal with numerous earthy substances, and the iron is, therefore, of no practical use until these are removed, and this cannot be effected without the aid of fierce heat and many complicated operations. Hence the smelting of iron occupies more attention, time, labour, and expense than the mere raising it from the hidden depths where it has been buried. In iron mines a gallery or trench is cut in the side of a hill, or a shaft is sunk according to the position in which the ore may be found. When this is decided, the miner with his pick and his shovel commences operations, and the dirt-coloured stony substance is loosened, shovelled into baskets, and then raised to the mouth of the mine. So heavy is this ironstone, and of such small value in its rough state, that the smelters generally contrive to have the smelting works as near as possible to the mine, in order to save the expense of carriage. And as the same reason applies to the coal so largely employed in smelting, and to the lime which is also used, we see why the great smelting works in South Wales, which are among the most famous of our manufactures, combine the mining and the making of iron on the same spot and on so gigantic a scale.

There is a great variety of iron ores, which have different names given to them by the workmen, and are of various qualities. *Native* or meteoric iron (to which I have already alluded) has been found in large masses in different countries, and which had no history, or were only alluded to in vague tradition. Of this kind is the immense mass seen by Pallas in Siberia, now in the Imperial Museum at St. Petersburg. The largest known is one in Brazil, estimated to weigh *fourteen thousand pounds*. This metal is very remarkable from the difficulty of accounting for its appearance on our earth. That it comes to us from beyond the world we inhabit, seems without doubt, but in what manner? The subject is so deeply interesting that I will endeavour, as plainly as possible, to give you the opinions of learned men on this point. The French astronomer, Laplace, and other scientific men, have supposed that these immense masses of ironstone have been projected on the earth from volcanoes in the moon. This conjecture has given way, however, to another, started, or at least powerfully advocated, by the celebrated German naturalist, Humboldt. According to this the phenomenon of *aërolites* (from the Greek *aër*, air; and *lithos*, stone), as meteoric ironstones, fireballs, and shooting stars are termed, are nothing else than very small bodies moving in space with regular directions, like those of the planets, but which, when turned aside occasionally from their course by approaching too closely so large a body as the earth, are drawn swiftly downwards through our atmosphere. What wonder-creating thoughts such reasoning awakens of the universe to which we belong!

> "Thou beckonest, Almighty!—from the tree
> The blossom's leaf doth fall;
> Thou beckonest—in immensity
> Is quenched a solar ball!

If it is true, then, besides the sun, the planets, their moons, and the comets—all of which are luminous bodies,—we are to reckon as members of the solar system an incalculable number of small masses, moving like dark particles of matter through heavenly space, and only made visible when they are so near one of the planets as to be drawn into its atmosphere; in which case, if it be during the day, they assume the appearance of meteoric stones, and if during the night, that of shooting stars.

It has been inferred that these asteroids, or meteors, go in streams, as it were, of *many myriads* together, and it is only at points where such streams intersect the earth's path that abundant showers of meteoric stones, or falling stars, take place. They fall in all seasons of the year, either singly or in numbers.

The masses of native iron and the pieces of stone which you may happen to see in public or private museums, after what you have read, will not fail to excite in you the greatest interest, for they are more than mere minerals. They are sent from regions beyond us, to show that the other planetary bodies, so far removed from us in the heavenly space, are made of very much the same materials as the earth on which we live. The number of recognised matters composing meteoric stones are about one-third of the whole number of elementary substances discovered on the earth, iron largely preponderating—in some instances upwards of ninety parts in one hundred of the mass.

When you happen to be in the British Museum, you will see in the Mineralogical Department some fine specimens of native iron. There is a fragment from a mass at Otumpa, in South America, the weight of which was estimated at about fifteen tons: another piece detached from the mass of Siberian native iron, to which I have alluded as discovered by Pallas. This meteoric iron was found on the summit of a hill on the banks of the Jenisey, where it was considered by the Tartars as a sacred relic, a gift sent direct from heaven. A mass of native iron from Atacampa, in Peru, is also exhibited as one of the rarities in the collection. A number of specimens are arranged in chronological order, beginning with the fragment of a stone which fell in Alsace in 1492, in the presence of the Emperor Maximilian, then king of the Romans, as he was about to engage with the French army: the entire mass weighed originally 270 pounds.

Captain Ross, in his arctic voyage, mentions that the Esquimaux made their knives from two pieces of meteoric iron found in Greenland. This iron must have been a great boon to the inhabitants of those distant regions. If you have read the voyages of the famous Captain Cook (who, in his youth, was an apprentice on board a collier vessel), you will remember how surprised he was at the avidity which the natives of the South Sea Islands displayed for iron. "Nothing," he says, "would go down with our visitors but metal, and iron was their beloved article." A nail would buy a good-sized pig, and on one occasion the navigator bought about four hundred pounds weight of fish for a few knives, made for the occasion out of an old hoop. The seamen found they could pay their way from island to island merely with scraps of iron, which were as useful for the purpose as gold coins would have been in Europe.

I have related what is conceived to be the origin of meteoric iron; another subject for wonder is the fact that in the lakes of Sweden there are vast layers or banks of *iron, exclusively built up by animalcules.* This term is applied to any very small animal, but limited in actual use to those which are seen through the microscope. Animalcules exist in prodigious numbers, and of many different kinds,—their size being such that multitudes of them find ample space within a single drop of water; and they abound almost wherever there is moisture, at least wherever there is organic matter present. The animalcules alluded to are not unlike those that have laid the foundations of large islands in the ocean, by cementing for many ages matter with matter, so as to form beautiful substances, amongst which is the *coral* you have often seen. M. de Watteville informs us that the iron thus formed by countless myriads of animalcules is called in Sweden *lake ore*, distinguished, according to its form, into what are termed gunpowder, pearl, money, or cake ore. In winter the Swedish peasant, who has but little to do in that season, makes holes in the ice of a lake, and with a long pole probes the bottom, until he has found an iron bank. An iron sieve is then let down, and with a sort of ladle, conveniently fashioned for the purpose, the loose ore is shovelled into the sieve, which is then hoisted up again. The ore thus extracted is of course mixed up with a quantity of sand and other extraneous matter, which is got rid of by washing it in a cradle like that used by gold-diggers.

But to return to the iron mine: the ironstone, when it is raised to the surface, is so hard and mixed with other matters that it is not fitted for the smelting process until it has been *roasted*. The ironstone, besides iron, stone, and hard clay, contains sulphur, arsenic, manganese, and other substances, and these must be got rid of before the ore is thrown into the furnace. This is the purpose of the roasting process. The ore is broken into small pieces, and mixed with coal, until a large heap is formed, which is then fired, either in the open air or a kiln, and by the time the coal has all burned away, the arsenic and other matters will have been removed, and the ore will consist only of earthy matters and oxide of iron. To remove these earths and the oxygen of the oxide is the object of smelting, and both coal and limestone are necessary to this.

If the ironstone is clayey, lime must be added; and if it is chalky, clay must be added. The coal takes up the oxygen of the oxide and dissipates, the lime and the clay unite and form an earthy refuse, and the iron is separated in its metallic state.

You will see how very fortunate it is that in most cases the ironstone and the coal necessary for smelting it are found in the same locality. The coal-fields in the south of Staffordshire, those of Monmouthshire, along with those of Gloucestershire and Somersetshire, supply more than three-fourths of the whole of the cast-iron produced in the kingdom. In some parts of South Wales the coal and iron appear nearly on the surface, while at others they lay at the depth of several hundred yards.

The smelting furnace for iron-works is a large structure of brick, having a small square receptacle for the fuel beneath, a large interior space for the ore to be smelted, a wide-mouthed chimney at the top, and air-holes at the bottom to admit either the hot or the cold blast. To explain this latter operation, I may mention that after the furnace is charged from the top with certain proportions of iron ore, coke, and limestone, the heat that would be produced in any furnace by merely setting fire to the fuel which is contained in it would be altogether insufficient for the fusion of the ore, if its intensity were not promoted by the forcing in of a current or blast of air. For this purpose it is necessary to employ a strong mechanical force, and of late years the agency of steam has been most commonly employed for this purpose.

The blast is carried into an intermediate chamber of a round shape, called a regulator, and as the air is in a state of condensation when admitted, its effort to expand itself again to its natural volume causes the continuous and regular supply to the furnace which is necessary. The air thus forced into the furnace keeps the heat at a degree of intenseness which is indispensable for the smelting of the ore. A most important invention was made by Mr. Neilson (to which we shall allude in our notices of eminent men connected with mining) in 1828, in using the *hot* blast instead of the *cold*,—that is, drying and highly heating the air before it is forced into the furnace. This has proved to be the most valuable and economical of all modern inventions in the iron manufacture; great saving being effected by it, as you will readily understand when, according to the former process, a large portion of heat was absorbed by the cold air, occasioning an unnecessary consumption of fuel.

The iron is run from the furnace every twelve hours, by tapping the front of it on a level with the bottom of the hearth. When the furnace is tapped the metal is allowed to run into channels formed in the sand of the smelting-house floor. The names of *sow* metal and *pig* metal, which were originally given by the workmen, signify, in one case, the blocks of iron which are formed in the large main channels; and in the other case, the smaller blocks, which are formed in smaller side channels, communicating with the larger ones.

The quality of pig iron varies according to the purposes for which it is intended, and depends not only upon the quality of the ore, but also upon that of the fuel. The principal division is into *foundry iron* and *forge iron;* the former being used for castings, the latter for conversion into malleable iron. When cast iron is broken its grain is found to be coarse and very brilliant. Every one of these grains of metal is thinly coated with a kind of glass, resulting from the fusion of the materials mixed with the ore. It is this coating which prevents the perfect contact and adhesion of the particles of the iron, and renders cast iron so brittle. The great difference between cast and wrought iron is that the former is very hard and brittle, and the latter soft and tough.

STEEL is a compound of carbon and iron. Bars of wrought iron of the proper quality are embedded in charcoal reduced to powder, and the whole is submitted to intense heat in cases made of bricks, and excluded from contact with the air. After a sufficient time the iron bars are found to be converted into steel. There is also another process, called *cast steel.* Steel is susceptible of taking a finer polish than can be given to iron, and by what is called "tempering," or giving to it different degrees of hardness, it is rendered of great use; this is done by raising the temperature in its manufacture, and then suddenly cooling it.

Wrought iron is prepared from the cast, the "pigs" being subjected to the action of another furnace, called the *refining* furnace, where they are melted and run into moulds, by which the remaining matters, such as earth and rust, are got rid of. The process of puddling is next performed, that is, stirring the iron until it forms into soft pasty balls, when it is taken out, and undergoes *shingling*, or beating by a large forge hammer, which is worked by a high-pressure steam engine; this gives the balls, or *blooms*, as they are called, a more convenient shape for going through the *rollers*. These rollers consist of two cylinders working in contact, and having on their surfaces a series of grooves, varying in size. The iron is passed through all these grooves in succession, until it is reduced to the required width and thickness. It is thus changed from a hard and brittle substance to a tough and elastic bar, which, from its property of yielding and altering its form under the hammer, has acquired the name of malleable iron.

It was towards the close of the last century that the great improvement was introduced of making bars and rods by passing iron through grooved rollers, instead of simply hammering it on the anvil. Until this invention all bars above three quarters of an inch square were thus subjected, while sizes below that limit were produced by *splitting*, which superseded a much less efficient process. How this was brought about in England is very curious. A man named Foley, who was a fiddler, living near Stourbridge, was often witness of the immense labour and loss of time caused by dividing the rods of iron necessary in the process of making nails. The discovery of the process called splitting, in works called splitting mills, was first made in Sweden, and the consequences of this advance in art were most disastrous to the manufacturers of iron about Stourbridge.

Foley, the fiddler, was shortly missed from his accustomed round, and was not again seen for many years. He had mentally resolved to ascertain by what means the process of splitting the bars of iron was accomplished, and without communicating his intention to a single human being, he proceeded to Hull, and thence, without funds, worked his passage to the Swedish iron port. Arrived in Sweden, he begged and fiddled his way to the iron foundries, where, after a long time, he became a universal favourite with the workmen ; and from the apparent entire absence of intelligence, or anything like ultimate object, he was received into the works, to every part of which he had access. He took the advantage thus offered, and having stored his memory with observations on all the combinations, he disappeared from amongst his kind friends as he had appeared, no one knew whence or whither. On his return to England he communicated his voyage and its results to a Mr. Knight and another person in the neighbourhood, by whom the necessary buildings were erected and machinery provided. When at length everything was prepared, it was found that the machinery would not act; at all events, it did not answer the sole end of its erection, for it would not split the bar of iron. Foley disappeared again, and it was supposed that shame and mortification at his failure had driven him away for ever. Not so : again, though somewhat more speedily, he found his way to the Swedish iron-works, where he was received most joyfully ; and to make more of their fiddler, he was lodged in the splitting mill itself. This was beyond his utmost hope. He examined the works, and very soon found out the cause of his failure. He now made drawings and rude tracings, and having stayed long enough to verify his observations, and to impress them clearly on his mind, he made his way to the port, and once more returned to England. This time he was completely successful, and by the results of his experience enriched himself and greatly benefited his countrymen.

A somewhat similar story to this (though without the accompaniment of a violin) is told of an iron-founder at Sheffield named Walker. I have already explained how steel is manufactured, and the process of making what is called *cast steel*, in which iron is presented in, perhaps, its very highest state of perfection. The value of this art will be understood from the many useful objects in which it is employed, namely, in cutting instruments for the surgeon, the chisel of the sculptor, the steel plate of the engraver, and an infinite variety of tools requiring durability and keen edges. Benjamin Huntsman, a native of Lincolnshire, but settled near Sheffield (a town that has been famous, from an early period, for its manufactures of iron and steel), was the inventor of cast steel. The discovery was kept a great secret, and as the success it obtained was very great, many efforts were made to find out the mode of operation, and Walker appears to have been the first to find it out. The story is thus told in a little book called "The Useful Metals and their Alloys:"—"One cold winter's night, while the snow was falling in heavy flakes, and the manufactory (Huntsman's) threw its red glare of light over the neighbourhood, a person of the most abject appearance presented himself at the entrance, praying for permission to share the warmth and shelter which it afforded. The humane workmen (who, we should mention, had been sworn to secrecy respecting the manufacture of the cast steel by their employer) found the appeal irresistible, and the apparent beggar was permitted to take up his quarters in a warm corner of the building. A careful scrutiny would have discovered little real sleep in the drowsiness which seemed to overtake the stranger; for he eagerly watched every movement of the workmen, while they went through the operations of the newly discovered process. He observed, first of all, that bars of blistered steel were broken into small pieces, two or three inches in length, and placed in crucibles of fire-clay. When nearly full, a little green glass broken into small fragments was spread over the top, and the whole covered with a closely fitting cover. The crucibles were then placed in a furnace previously prepared for them, and after a lapse of from three to four hours, during which the crucibles were examined from time to time, to see that the metal was thoroughly melted and incorporated, the workmen proceeded to lift the crucible from its place on the furnace by means of tongs, and its molten contents, blazing, sparkling, and spurting, were poured into a mould of cast iron previously prepared; here it was suffered to cool while the crucibles were again filled, and the process repeated. When cool the mould was unscrewed, and a bar of caststeel presented itself, which only required the aid of a hammerman to form into a polished bar of cast steel. How the unauthorized spectator of these operations effected his escape without detection is not mentioned, but before many months had passed the Huntsman manufactory was not the only one where cast steel was produced."

This, you will agree with me, was a very unfair trick of the Sheffield iron-founder; but it did not prevent the inventor from realizing large profits from a process which had cost him years of patient and laborious work to mature. But Huntsman was a man of genius, a good chemist, and devotedly attached to scientific pursuits, and men with these qualifications are sure to attain eminence.

One of the most important assistants in the manufacture of iron is the celebrated *Nasmyth's steam hammer*, which has been described as "one of the most perfect of artificial machines, and noblest triumphs of mind over matter, that modern engineers have ever developed." This powerful instrument possesses so much precision and delicacy, that it will chip the end of an egg resting in a glass on the anvil without breaking it, while it can deliver a blow of ten tons with such force as to be felt shaking a parish. The value of this invention will be understood when we are told, that when the use of iron extended, and larger iron work came to be forged for common tools and machinery, the ordinary hand-hammer was found insufficient, and the forge-hammer came into use. This was usually driven by a water-wheel, or by oxen or horses. The invention of the steam hammer by Mr. Nasmyth originated in the following manner, as related by Mr. Smiles in his very interesting "Industrial Biography:"—"In the early part of 1837 the directors of the 'Great Western Steamship Company' sent Mr. Humphries, their engineer, to consult Mr. Nasmyth as to some engineering tools of unusual size and power, which were required for the construction of the engines of the *Great Britain* steamship. These were in hand, when a difficulty arose with respect to the enormous paddle-shaft of the vessel, which was of such a size of forging as had never before been executed. Mr. Humphries applied to the largest engineering firms throughout the country for tenders of the price at which they would execute this part of the work, but to his surprise and dismay he found that not one of the firms he applied to would undertake so large a forging. In this emergency Nasmyth was applied to, and his mind immediately directed itself to the invention of the ponderous steam hammer that now bears his name."

CHAPTER XIII.

MINING ADVENTURE IN RUSSIA.

I WILL now direct your attention to one of the most powerful countries in the world—the empire of Russia, which extends over a large proportion of the northern regions of the globe, and contains a population exceeding seventy millions. A great and wonderful country it is, abounding in industrial resources, one of the most important of which arises from its mines. Siberia, that vast territory in Northern Asia belonging to Russia, has many mines of gold, silver, copper, iron, and other metals. You have no doubt heard of this cold and dreary country, which in some parts is covered with snow and ice during the greater part of the year, and more than half the inhabitants of which are exiles, sent there by the Russian Government for political offences or for crimes. Most of these miserable people are kept to hard labour in the mines, others are put to less severe work, but still under compulsion, and another portion are allowed to work for themselves under the control of the police.

> "There through the prison of unbounded wilds,
> Barred by the hands of Nature from escape,
> Wide roams the Russian exile. Nought around
> Strikes his sad eye but deserts lost in snow,
> And heavy-loaded groves, and solid floods
> That stretch athwart the solitary waste
> Their icy horrors to the frozen main."

The greatest quantity of gold obtained from the mines of Siberia in one year was about seventy-five thousand Russian pounds. This was considered enormous, but California and Australia have made this amount appear small in comparison. The Ural mountains, which form the natural limit between Europe and Asia, contain the greater portion of the mineral riches of Russia, and it is here that the principal mining works are established. They produce, besides other metals, gold, copper, and iron, the last of which is of excellent quality. Emeralds and jaspers are also found, as well as diamonds of an inferior kind.

In 1824 the Emperor Alexander I. visited these extensive mining districts, and particularly one mine where large pieces of gold had been found. Lumps of this precious metal several pounds in weight were worth digging for, and this perhaps induced the Emperor to make a trial with his own hands. After digging for upwards of an hour, his Majesty began to feel that wielding the pickaxe and shovel were more trying to his strength than holding the sceptre. A workman, accordingly, continued the excavation, and at the depth of two feet below where the Emperor had left off digging, a lump of gold weighing several pounds was discovered. To commemorate this event, and to point out the exact spot over which his Majesty worked as a gold-digger, a small pyramid was raised.

These mines continued to yield gold for many years. In 1843 another large lump was found at no great depth, weighing seventy pounds. Years before, the miners had excavated all around this spot, little dreaming of the treasure over which the workmen trampled daily. The peasant or slave who discovered this large mass was made free by the late Emperor Nicholas, and a pension granted to him for life.

The Russian mining engineers are among the most skilful and persevering that are to be found in any country. No class of men in that empire can equal them in scientific knowledge and general intelligence. This is, however, due in a great measure to English teaching, for miners and mechanics from our country have been employed in the mines of the Ural mountains and elsewhere in Russia for many years. I will relate to you what I have read about one of our countrymen, a clever mechanic named Major, who was engaged during the reign of the Emperor Paul to superintend a small mechanical establishment at a place called Ekaterineberg, the principal mining district of the Ural mountains. In this town Major spent a long life, and made many machines, which, although rough in the workmanship, proved of great value in easing the labour of the miners. He had many difficulties to get through, for the peasants who were sent to him were very ignorant, and had never in their lives seen any of the tools he employed except an axe, a saw, and a hammer or spade. Major entered upon his duties, scarcely knowing a word of the Russian language, but in the course of a year he managed to learn sufficient for his purposes from the miners. His salary was liberal, and provisions cheap, so that he was able to live very comfortably.

Major was very singular in his habits, and particular about the machinery under his charge being kept in good order. When dressing in the morning he invariably put on three pairs of stockings, and a pair of wide Russian boots over them. Thus prepared, he would start on his rounds of inspection, and the first mud he discovered, he would call the engineer of the mine he visited and scold him soundly; he would then sit down, pull off his boots, and draw off a stocking, with which he would remove the dirt. He would then proceed to the next mine, repeating the same operation when necessary, leaving a stocking at each place where it had been used, and returning home in the evening, sometimes with one stocking on, but more frequently with bare legs. Woe betide the delinquent who failed to bring home the stocking left at his post! for the birch would assuredly refresh his memory the next morning; he never forgave this neglect.

When the Emperor Alexander I. visited the mines in the Ural he was greatly pleased with the works Major had established, and as a token of his satisfaction, presented him with a piece of land containing about twenty English acres, and all the minerals it contained, among which, it was said, gold had been found.

Major built a house here, and began to excavate and wash the gold-sand, usually obtaining gold, yearly, to the value of about three thousand pounds, at a very small cost of labour. He had gone on in this way for several years, living at his country-house, with few people in the neighbourhood, and having no one with him but an old woman as domestic. The gold-washing ceased about the middle of each September, and the workmen employed returned to their homes for the winter. The quantity of precious metal obtained during the summer was accurately known to these men, each day's produce being weighed, entered into a book, and delivered to Major every evening. He used to place it in an iron box which stood in his office, and carried the key in his pocket. This year had been more than usually productive, and there were more than one hundred pounds weight of gold in the box. It was also known that within a very short time of the works closing, the engineer would send this box and its contents to the smelting-works to be cast into bars, after which the latter would be forwarded to the mint at St. Petersburg.

One Sunday evening Major and his old housekeeper were alone in the house; he was occupied in his office, and she was sitting in her own room near the entrance-door. Suddenly her attention was drawn to a noise in the outward lobby, which induced her to leave the room. The moment she got into the entrance she was seized, and thrown down a staircase which led to some apartments below. Her screams and the noise brought Major to the door of his office with a candle in his hand, when a blow from an axe fell upon his head, and he never breathed again. After this the murderers took the box and the gold, ransacked the place in search of other treasure, and then left, closing the door after them.

All this time the old woman was lying at the foot of the stairs insensible. It was not until the morning of the third day after the horrible deed that one of the engineers under Major came from the mine to consult his master on some business of importance. On reaching the house, he noticed that no smoke was rising from the chimney, the windows were closed, and a solemn stillness prevailed over the place, which led him to think that something was the matter. After securing his horse in the usual place, he ascended the steps and entered the house, where lay the mutilated body of his master, his hand still grasping the candlestick. Rushing from the house he sprang into the saddle, and galloped off to announce the terrible discovery. Presently the police officers were seen hurrying to the house, the news spreading rapidly, and causing a great sensation. Search was made, and the old woman was found at the bottom of the stairs, still living, but insensible. Every means were employed to restore consciousness, which in time was effected. It was only then that she learned what had befallen her master, but she could give no description of the murderers. A strict investigation was made, and it was ascertained that the gold had been carried off, but the papers and letters on the table had been left untouched. The housekeeper remained in a very dangerous state: so great had been the injuries she received in her fall, and the effect which had been produced on her mind by her master's death, she relapsed into a state of unconsciousness, and remained so several weeks. At length she revived, her mind began to calm, and her reason was perfectly restored. Great hopes were now entertained that she would be able to give some evidence by which this mystery could be unravelled. It was well known that Major was accustomed to sit up until a very late hour, and the woman proved without doubt that the murder had been committed about a quarter before two o'clock in the morning. She had been seized so suddenly that she could not tell how many were in the lobby, but she thought only three. This was all the evidence that could be obtained; a strict watch was however kept over the conduct of several workmen, in the expectation of some amongst them trying to dispose of the gold. One of them was a small trader, whom the police had some reason to suspect. He was taken and examined, but proved clearly that he was a great many miles distant from the scene of the murder after six o'clock in the morning, so he was liberated.

Years passed away, the horrible fate of poor Major was often the subject of conversation at Ekaterineberg, but all hope of penetrating the mystery in which it was enveloped was given up. At this time the quantity of gold stolen from the mines, and sent into Tartary and Bokhara, had become so enormous, that the Russian Government determined to discover how it was effected. An officer of police was sent to Ekaterineberg, where he arrived disguised as a peasant. His passport was in order, and so well was his object kept secret, that even the police of that district and other authorities believed him to be what he seemed. He soon got into favour amongst the miners, living and drinking with them, hearing all that passed, and gradually acquiring from his unsuspecting associates the information he wanted. He discovered that there were persons engaged in these gold robberies who lived far away from Ekaterineberg, and through whom the precious metal was got out of the country. During his stay among the peasants in the town and at the mines, he provided himself with gold, and now changed the locality of his operations. Without exciting any suspicion amongst his companions, he left for Omsk, to dispose of his stolen treasure, and he was even entrusted by some of his friends with small parcels to sell for them. Shortly after his arrival in the western capital of Siberia, he began to associate with the Tartars, and very cautiously let them know that he had some gold to sell. This was done in so professional a manner, that he was soon introduced to the principal gold dealer, whose influence was so great that the Tartars did not dare to purchase gold, unless it had passed through his hands. Several anxious days ensued, when one morning a Tartar acquaintance called, and said the police had been making inquiries about his visit to Omsk, which might lead to unpleasant circumstances; he therefore proposed that the gold should be sold without delay, and offered to accompany him to the dealer. You may be sure that the disguised peasant was glad to hear this, and was soon ready with his parcels. The Tartar told him to be under no apprehension when he saw the buyer, as it was all right and safe. On they went, and the guide, after a long walk, led him through a yard into a large house, taking him at once into a room, in which stood a table covered with a great heap of papers. The Tartar then went out, returning in a few minutes, and saying that the gentleman would see them shortly. It was not long before a man came in who asked the assumed peasant, in a rude manner, how much gold he had stolen, where he came from, and a variety of other questions calculated to frighten him. All these were answered in a very submissive tone. The gold was then ordered to be produced, which was done, and the weight of each packet marked on it. The Tartar was told to pour all the gold into a scale, but to this the peasant objected. He was, however, instantly informed by the dealer that it all belonged to thieves, and they must settle it amongst themselves. It was found to weigh much less than the seller knew it to be, when he quietly suggested that the scales might not be correct. The other turned upon him with a frown, exclaiming in an angry tone, "What, thief, you are not content with robbing your employers, but you wish to cheat me! I shall soon hear of your punishment. What is your price?" The man named the sum, and was offered half, but declined to take so small an amount, intimating that he would try some other dealer. This roused the anger of the dealer. "I will give you," he said, "five minutes to consider whether you will take the money I offer, or be handed over to the police." The peasant pretended to be very penitent, and promised that in all future dealings with him he would never offend again. After this he received his money, and was told to be diligent, and get more gold. He was then dismissed, with a threat that if he did not keep secret what had occurred, he would be severely punished. The Tartar also gave him some advice as to what he should do in future, and introduced him to several of his friends, who were engaged in the same traffic. The following morning the scene was changed; the police officer was seen driving through the streets of Omsk, followed by two mounted soldiers. He went straight to the house of the chief of the police of the town, who received him with great politeness, not recognising his visitor of the preceding evening, and when the soldiers were called in to take him to prison, he appeared as if struck dumb. The smaller agents were left for other parties to secure, and several of the Tartars succeeded in making their escape.

The police officer having accomplished his mission at

Omsk, now started for Ekaterineberg, to complete what he had so well begun. The first person arrested was the small trader who had been examined, and acquitted of Major's murder. He was again accused of this crime, and two other men were soon in custody on the same charge. The wife of the trader revealed where the gold had been hidden, and on searching for it, the axe was found with which the murder had been committed. This man had been long engaged in smuggling stolen gold. For this purpose he required good horses, and he possessed one of extraordinary power and speed. Immediately the gold had been hidden, after the murder of Major, he mounted his horse, and in about four hours, having ridden with wonderful haste, he reached a town called Kamenskoi, about fifty miles distant, where he took care to be seen by the police. As it was considered impossible, at the time of the murder, for such a feat to be accomplished, he got off, but it was now proved that he was the actual murderer, and his two associates had assisted him. All three were condemned to "run the gauntlet," that is, to walk between the lines formed by two regiments of soldiers, consisting of three thousand men, each man striking them a terrible blow with a rod. The three murderers died under this punishment. The bands of gold stealers were soon broken up, and many of them severely dealt with. The police officer returned to St. Petersburg, and received a substantial reward for his arduous and dangerous labours.

> "Puissant gold! red earth at first made man;
> Now it makes villain: this refined clod
> Does what nor love, nor time, nor valour can;
> Jove could do more in gold than as a god.
> Destruction surer comes, and rattles louder,
> Out of a mine of gold than one of powder."

While on the subject of Russian mining, I will give you some particulars respecting a curious and interesting "training school," or "college for miners," established at St. Petersburg. An association of miners was founded by Peter the Great, for the education of mining engineers, and to render them capable of exploring the mineral resources of the empire. The building devoted to this purpose is sufficiently striking, to attract the notice of the traveller in the Russian capital; the present edifice is, however, of much later date than the original. Entering by a broad flight of steps, under a noble portico, we reach a spacious ante-chamber, from which several long halls branch off, leading to the different departments of the establishment. The building encloses a hollow square, and covers a space of many hundred feet in extent. No ticket of admission is required; you ascend a flight of steps, walk into the secretary's room, and after the name of the visitor is inscribed, enter at once the Museum, which is singularly attractive. Murray gives the following account of the college:—"It is the chief of various schools scattered throughout the mining provinces of Russia, and is composed of forty scholars, who have attained the rank of officers, and two hundred and eighty pupils, one hundred of whom are educated and maintained at the expense of the government, and one hundred and eighty, either at the expense of their friends or of the directors of the provincial mining establishments. The pupils supported at the public expense are sons of persons employed in the Government mines; the other pupils must be either children of noblemen, clergymen, or merchants of the first guild, or station. They must remain eight years in the establishment; their education is extensive and liberal, embracing also dancing, music, fencing, &c. After they have finished the several branches of study required, they are sent to superintend the Government mines, or are placed in the mint. They hold a military rank and wear a uniform."

Among the beautiful rich and rare specimens in the Museum is one of gold, taken from the mine of Alexandrofsky, in the Ural mountains, about eighty pounds English weight. There is another large mass of great value, an immense block of malachite (a beautiful green mineral, used for many ornamental purposes), weighing several thousand pounds, and numerous specimens of metals, precious stones, jewels of great price, enough to convince one of the wonderful riches of the Russian mines. These are all admirably arranged in cases. The halls and galleries are filled with models, implements, tools, and machinery adapted to the different mining regions. There are also *fac-simile* representations, in miniature, of several mines, showing in what manner the metals are worked, and the kind of machinery employed. Many curious objects are scattered through the halls, such as the bones of a human being found embedded in the trunk of a tree, mammoth bones, and the great mass of meteoric iron, to which I have already alluded as discovered by Pallas in Siberia, and which, after having been reduced in size by pieces sent to various foreign collections, still measures upwards of three feet square.

Having visited the bright side of the Museum, and looked with wonder at the wealth wrested from the dark caverns of the earth, we ought now to look at the other side of the picture, in order to realize in some measure the toil, labour, hardship, and suffering spent in bringing all these precious metals and jewels to light. A guide precedes the visitor with two candles in hand, and after passing through several passages, and unlocking two ponderous doors, he is led into the gloomy recesses of a *counterfeit* mine, absolutely underground, furnished with all the machinery, tools, and implements used in a real mine. Here the pupils of the mining college are instructed, by an exact representation of various mines, how the different ores are found. But as it is damp, cold, and dark, visitors are too glad to reach again the lighter and warmer quarters above ground.

CHAPTER XIV.

THE LEAD MINES OF ENGLAND AND SPAIN.

I HAVE always thought that a visit to factories, where the arts that tend to civilize mankind are in active operation upon a large scale, is one of the greatest enjoyments that a young and inquiring mind can have. I think you would find few more interesting than a LEAD FACTORY, where you would be able to understand some of the many purposes to which this extremely useful metal is applied. But I will not pursue this part of the subject, as I wish more particularly to direct your notice to the mines in which lead is produced. There are two processes of lead manufacture I would, however, recommend you to observe when you have the opportunity, not only on account of the ingenious methods adopted, but from the very general uses to which the articles are applied. You would see how *sheet lead* is made (which is so useful for covering the roofs of houses and terraces, and for lining cisterns) by the modern method of "milling" or "rolling." Plates or sheets of this metal were employed in ancient times for writing upon. Hesiod, next to Homer the earliest Greek poet of whom we have any knowledge, and who is supposed to have been born in the eighth century before Christ, wrote seven of his books on sheets of lead; and Pliny, the Roman historian, born twenty-three years after the birth of our Saviour, tells us that the public acts in his time were preserved on plates of lead. But the most ancient mention of the use of lead, in plates or sheets, you will find in the Book of Job (chap. xix., ver. 23, 24): "Oh that my words were now written! oh that they were printed in a book! that they were graven with an iron pen and lead in the rock for ever!" proving that lead, in the earliest times recorded, was applied to the fine arts.

Montfaucon purchased at Rome, in 1699, an ancient book, entirely composed of lead. It was about four inches long and three inches wide; and not only were the two pieces that formed the cover and the leaves, six in number, of lead, but also the stick inserted through the rings to hold the leaves together.

Historians mention the use of solid sheets of lead for covering purposes in reference to the stupendous hanging gardens of Babylon, attributed to the king Nebuchadnezzar you read of in the prophet Daniel.

The other process of lead manufacture to which I have alluded to be observed in a lead factory, is the making of pipes by "casting" and "drawing." The most extensive use of lead is in the form of sheets and pipes; the latter being employed for the conveyance of water, and used for this purpose by the ancient Greeks and Romans. Gas is also conveyed in this manner, and gutters are made of the same material for carrying off rain-water from roofs.

A striking illustration of the employment of lead for water-pipes in the time of Cardinal Wolsey occurs in the instance of Hampton Court Palace, which is supplied with water from some springs in Coombe Wood. The distance is two miles in a direct line. There are two pipes from each conduit, making eight miles of leaden pipes.

Lead, as we have thus seen, was known in the earliest ages; and although it probably never occurs in a native state (apart from the ore in which it is found), still the ore of lead is extremely abundant, and admits of reduction by a very rude application of fire. It is found in combination with other substances, especially with sulphur, and was anciently known as *galena*, from the Greek, signifying "to shine." It has a lustre resembling that of the pure metal, but is instantly distinguished from it by readily breaking when slightly struck by a hammer. The ores of lead are white, green, or blue, especially the latter. The mode of extracting the metal from the ore is somewhat similar to that adopted for copper and tin. The ore is generally found in veins of rocks, and has to be dug out in masses, which are often mixed with earthy matters. These masses are broken into small pieces, and then crushed fine, and the whole washed in a stream of water, which carries away a great part of the earthy matters, owing to their being lighter than the lead ore. The remaining ore is collected and dried, then subjected to the operation of smelting. In this way the lead sinks to the bottom of a furnace, from whence it is run out into oblong moulds, and in these it cools into solid masses called "pigs," and is sufficiently pure for all ordinary purposes.

In our own country the ore of lead was so abundant in ancient times that it was forbidden to extract more than a certain quantity annually. The ore was found actually upon, or only beneath the surface of the earth to a slight depth, in Derbyshire, where it was chiefly wrought by the Romans, who appear to have been ignorant of the rich deposits of lead in Cumberland. Sir Roderic I. Murchison says that lead cast in Roman moulds (pigs, in fact, as they are now called) has been found in Scotland (Fifeshire), Derbyshire, Yorkshire, and some other counties. The shape of the ancient ingots, or "pigs," is nearly the same as at present, and the inscriptions were made in raised letters on the top. This is worthy of observation, because if these letters were raised in the mould, and thus appear raised on the top, it seems singular that this did not suggest the idea of printing.

Lead is one of the softest, most ponderous, and most widely diffused, and, generally speaking, best known of the perfect metals. For the purposes to which iron is generally devoted, lead would be utterly useless, while to many of the uses for which the precious metals are consumed, lead might be applied. When newly melted, this metal is very bright, resembling tin, but less silvery; on cooling, however, it soon becomes tarnished, and on exposure to the air assumes the dull bluish hue generally known as lead colour.

Mr. Sopwith, in his account of the mining districts oi Alston Moor, Cumberland, thus describes a visit to a lead mine:—"The party, being suitably arrayed, have sometimes to wait a little until the waggons come out, and meanwhile are furnished each with a candle, round which a piece of clay is fixed to hold it by. At length the rumbling noise of approaching waggons rapidly increases, and their contents having been deposited, they are prepared for the visitors, the inside being cleaned, and a board placed at each end for a seat. The entrance to the mine, or the level mouth, resembles an open arched doorway, into which the waggons are driven at a moderate pace, and the visitors experience the novel sensation which so unusual a conveyance is apt to create. The jolting, tottering motion of the waggon, the splashing of the water, and the dark and narrow passage, all concur to produce a strange effect, which, however, soon wears off, and the subterranean traveller finds leisure to observe the rugged roof and walls of the level, or to listen to the guide urging forward his horse in tones which the echoes of the mine often render musical. Even the fragment of a song from the driver sometimes enlivens the journey, but on no account is whistling allowed in a mine. The same prejudice exists among seamen on board a ship, but the origin of this superstition is not known. The ascent, or what the miners call a *rise*, is frequently attended with some difficulty, especially to ladies; but the gallantry of the gentlemen and the civility of the miners soon overcome the apparent dangers, and one by one they are raised into the workings of the vein. Hence the party are conducted along the mine drift of the vein, and this part of the expedition must, of course, vary in different mines; in all, however, the stranger is apt to be impressed with feelings of awe at the idea of being so far underground. The contemplative mind cannot but find many interesting subjects of reflection on the distribution of so much wealth in a country otherwise so barren: the various uncertainties which are the means of such extensive employment—the fluctuations of fortune so often resulting from mining adventures, and the ingenuity displayed in prosecuting them, are all circumstances which may engage the attention of a reflecting mind. To the mineralogist the interior of a mine, especially if it contains any spar-encrusted caverns, is a sort of 'home, sweet home,' where the lovers of the sciences of mineralogy and geology may derive copious stores of intellectual enjoyment.

"The progress along vein workings is often with cautious steps and slow, especially among the intricacies of flat workings, the friendly hint of 'take care you do not fall down the rise' sometimes calling the visitor's attention, absorbed perhaps in other thoughts, to a yawning gulf not to be passed over without caution. Sometimes an almost perfect stillness is suddenly broken by a noise like distant thunder, the report of a blast, which, rolling through the workings of the mine, at length, after many reverberations, dies away. The noise of rubbish falling down a rise and the rumbling of the waggons occasionally salute the ear; the sound of the latter, gradually increasing and lessening, resembles the solemn effect of distant thunder.

"The miners usually describe the blasting and other modes of working the ore, and frequently fire a shot for the entertainment of the visitor; but when near at hand the effect is by no means so striking as when distance softens the noise, and adds repeated echoes to it. At length, arrived at the far end, or 'forehead,' as the miners term it, of the vein, the party usually rest. The miners work by what is often, in other trades, called piecework, so that the time spent with strangers is taken from their own labour, and the expense of candles is also at their own cost. By the latter is meant the custom of miners of not putting out their candles, however numerous the visitors may be, causing a brilliant illumination, twenty or thirty candles being sometimes placed against the walls. The conversation of the miners sometimes has a curious effect, from their assuming, as it were, a sort of feeling in the mineral world. Thus they speak of a vein being 'frightened' to climb the hill; and that she, therefore, 'swims away' to the sun-side (a feminine appellation being generally used). The throw of the strata is attributed, as it were, to an 'act' of the vein,—'she throws the north cheek up;' these are homely, but they are also expressive modes of describing what they have occasion to speak of, and they save a world of words.

"Ladies seldom pursue a subterranean excursion further than the main workings, or such others as are easily accessible, while their more adventurous companions frequently accompany the guides into other parts of the mine. In so doing, obstacles present themselves more difficult of accomplishment than those already described. Lofty rises, with rude and slippery 'stemples' (pieces of wood placed at two opposite sides, three or four feet above each other), are sometimes found awkward to climb, and still more so to descend. It sometimes happens that these *stemples* are covered over with boards, to prevent them from being injured by the falling ore, thrown from the workings above, and the only foot holds then to be had are the spaces between these boards. The attention of the miners, however, who climb and descend with perfect confidence, prevents any real danger, though to a stranger the idea of climbing fifty or a hundred feet on so perilous a footing, is seldom unattended with some sense of fear.

"Journeying through the drifts, or passages, of a narrow vein is a less dangerous, but often equally fatiguing task, especially if, by reason of accumulated work, the hands and knees are to be put in requisition for several fathoms over sharp angular blocks of rock, which all but fill the narrow passage. At the end of such drifts, buried, as it were, in a deep and lonely cavern, a single miner is often found pursuing his solitary labours at a string, or thin vein of ore, which, like a bright silvery stream, is seen traversing the rock. It is considered that, in general, a solid rib of ore, two or three inches wide, will pay for working; and as a much greater space is required for *vein-room*, the procuring this slender thread of ore is attended with a great proportion of unprofitable labour, hence the inconvenient but economical narrowness of the drift. The persevering visitor, who would explore every part of a mine, after *descending the rise* to a level, is probably next taken to the head of a pit, where he is required to trust his person to a substantial rope hung on the axle of a hand-whimsey (a roller and handle similar to what are commonly used for draw-wells), often of apparently frail construction, and is thus lowered down into the deeper workings of the mine, the aspect of which is similar to those above.

"The subterranean researches of our visitors being at length completed, the waggons are again entered, and the eye, accustomed to such scenery, surveys with greater clearness the strata of the roof and sides,—pendent drops are seen hanging from above, and the wooden posts, which in some places support the level roof, are covered with woolly, snow-like fungi. The timorous sensations felt on entering are now dissipated, and the party can fearlessly look at these and other swiftly-passing objects, on which, at length, a faint white gleam of light is seen to blend with the yellower rays of the candles. The rocky prominences become more and more illuminated, and the solar light, together with the sparkling drops of water, impart so bright and silvery an aspect as to excite the greatest admiration. This rapidly increases, until, amid the splashing of water and the noisy rattling of their rugged cars, the party emerge from the dark chambers of the earth to the magnificent and almost overpowering brightness of the day."

The lead-works of the London Lead Company, at Nent Head, four miles from Alston, are on a large scale. Mr. Walter White says:—"In some places the metallic veins lie open to the daylight. Higher up the hill stand the smelting works where the ore is roasted and melted, and cast into pigs of lead. In roasting, the ore is spread on the sole or floor of a furnace, and is heated to a temperature at which it parts with its sulphur and takes up oxygen, but does not melt. In another furnace it is melted, and you see the molten stream flowing from the mouth into a pot. In another, the stubborn slag, or the dross and refuse, is treated by a roaring blast, becomes docile, yields every particle of lead, while splendid blue and green flames leap and play in the impetuous current. You see how even the sweepings of the chimney are converted into metal by the action of fire; how silver is separated from the baser metal; and not the least astonishing among the strange sights is the huge water-wheel, exceeding in circumference, perhaps, all that you have ever seen before, which drives the condensing apparatus."

Lead is the most malleable of all metals; it may be spread out by hammering with the greatest ease, and the slightest stroke is sufficient to indent a solid lump. It is remarkable that lead, under the hammer, neither becomes harder, nor is its weight increased, as is the case with other metals, upon which beating produces the effect of compression. Although its ductility is not great, it may, nevertheless, be drawn into wire, in which state its tenacity is considerable. Spun-lead, or lead-wire, is extensively used for horticultural purposes, as it is capable of resisting atmospheric influences.

It is often supposed that England, so rich in regard to iron, copper, and tin, is comparatively poor in lead, or at least that the lead mines are of secondary importance. This is an error, arising from the fact that the production of lead, instead of being concentrated in a few districts like that of copper and tin, is spread over a great number of mines. Some, like those of Alston Moor, in Cumberland; Snailbatch, in Shropshire; Wanlock, in Dumfriesshire; Laxey, in the Isle of Man, are indeed well known, but most of the others are comparatively unknown. Their number, however, is considerable, and they raise the production of this metal to an amount which may perhaps place England at the head of supply in this respect. Spain is, at any rate, the only country that can come into competition with her.

Of the lead districts in England, the most noted are the Mendip Hills (formerly very famous), in Somersetshire; about Hexham, in Northumberland; and the High Peak, in Derbyshire. In the earliest periods of lead mining in this country the ore was smelted on the tops of high hills, by fires made of charcoal and wood, and blown by the wind only; these ancient hearths were termed *boles.* One of the bleak eminences near Chesterfield, crowned with a fine plantation, has been celebrated by Montgomery in some charming verses called "Bole Hill Tree." These very ancient wind hearths were succeeded by "slag-mills" (slags are vitrified cinders of metals), somewhat like a blacksmith's forge on a large scale, and blown by bellows, worked by men or horses.

The uses of lead are multifarious; it is employed in making the fine kinds of glass, enabling them to bear the sudden changes of heat and cold better; also to give glass a proper degree of weight, and render it more easy to be cut without breaking. Lead gives to glass a greater power of refracting the rays of light, and confers upon it a higher polish.

A mixture of lead with tin forms *pewter*, and the same metal in different proportions makes that useful article to plumbers and others, *soft-solder*.

Lead, in the condition of sheets, has long been employed in this country for the preservation of the bodies of great personages, and is still in common use for coffins. You have often seen the thin sheet lead with which boxes of tea, imported from China, are lined. The manufacture of this by the Chinese is very simple. The lead plates are not rolled, as from their extreme thinness might be supposed; nor even hammered, as the appearance of the surface might indicate; but actually cast at once in the state in which we see them. Two men are employed; one of them is seated on the floor, with a large flat stone before him, and with a moveable flat stone-stand at his side. His fellow-workman stands beside him with a crucible filled with melted lead; and having poured a sufficient quantity on the slab, the other lifts the moveable stone, and placing it suddenly on the fluid lead, presses it out into a flat and thin plate, which he instantly removes from the stone. A second quantity of lead is poured on in a similar manner, and a like plate formed the process being carried on with singular rapidity. The rough edges of the plates are then cut off, and they are afterwards soldered together for use.

Large quantities of lead are used for the manufacture of shot and bullets, so distinguished as the round masses are small or large. The smaller kinds of shot are made by pouring the metal from a considerable height, in consequence of which it separates into globular masses of different sizes, which cool during their descent, and in the water into which they fall.

The shot towers on the south bank of the Thames in London, where these processes are carried on, are well worthy a visit. The invention of this method of making shot is said to have happened in a curious manner about the year 1782. William Watts, a plumber, of Bristol, or as some say, his wife, dreamt one night, that by letting melted lead fall from a considerable height into water, the drops would become round, and a great improvement might thus be effected in the manufacture of shot. The experiment was tried from a tower of St. Mary Redcliffe Church, at Bristol; and the result proving successful, he erected a manufactory, and obtained a patent, which he sold for ten thousand pounds. Here his good dreams left him, for he expended his money in building houses at Clifton, for which immense excavations were necessary, and the half-finished parts of the buildings were long afterwards called "Watts's Folly."

The common ore of lead is made use of as a glazing for coarse pottery. *Litharge*, which is obtained on a large scale by the oxidation or crusting of lead in a current of air, when it forms a scaly mass of a yellow or reddish tint, is much used in *assaying* or testing the qualities of metals as a *flux* to facilitate the fusion of ores. Litharge enters largely into various compositions, amongst others it is employed by chemists in the preparation of plasters. Combined with another proportion of oxygen it forms *red lead*, which is also used in the manufacture of flint glass, and as a paint. *White lead*, which is also used as a paint, is a mixture of the metal with oxygen and carbonic acid. *Sugar of lead*, so called from its sweet taste, is a compound of lead and vinegar, and is used very largely in several manufactures, particularly in calico printing, and also in medicine, as an *external* application. The ancients knew that it had the quality of rendering harsh wines milder, but they were not aware that it was poisonous.

White lead works are most common in London and at Newcastle-upon-Tyne. The process of obtaining this is so curious that it deserves explanation. The lead employed is of the purest quality, and is cast into the form of "stars," or circular "gratings," of six or eight inches in diameter, and from a quarter to half an inch in thickness. Five or six of these are placed one above another in the upper part of an earthen vessel, resembling a common flower-pot, into which a small quantity of strong vinegar has been introduced. These pots are then arranged, side by side, upon the floor of a long brick chamber, and are embedded in a mixture of new and "spent" tan from the tanyard; this first range of pots is then covered with loose boards, and a second range of pots is placed upon them, likewise embedded in tan, and so on until the chamber contains several "stacks," each consisting of twelve thousand pots, containing from fifty to sixty tons of lead. These arrangements being completed, the tan soon heats, as it does in a gardener's hotbed, the vinegar rises in vapour, passes through the openings in the gratings, and between the angles of the stars, gradually rusting their surfaces, inducing the formation of protoxide of lead (or first oxide that the metal is capable of forming), then combining with it to form the compound called *acetate*, or sugar of lead; this is afterwards decomposed by the carbonic acid produced by the fermentation of the tan, and forms carbonate of lead or white lead.

This operation is allowed to proceed for about six weeks. The stacks are then unpacked, and the gratings and stars are either found greatly or entirely corroded, containing in the one case only a mere skeleton, and in the other no trace whatever of the metal, but retaining its original form, though in perfectly white lead. This is broken from the remaining skeleton (which is remelted and recast) and crushed between heavy rollers, then ground to fine powder, washed with water, and allowed to settle until it becomes a fine paste, which after being dried is known as dried white lead.

Lead reduced from galena, or sulphuret of lead, always contains a little silver, of which eight or ten ounces to the ton is a very common proportion. The separation of this silver is now greatly facilitated by means of a de-silvering process, patented by the late Mr. H. Pattinson, of Newcastle-on-Tyne. This is so very interesting that I will explain it to you. The lead is melted and allowed to cool slowly, at the same time the mass is briskly stirred. A portion of the lead is thus allowed to crystallize in small grains, as pure lead becomes solid at a lower temperature than when mixed with silver. In this operation a row of about nine cast-iron pots are used. They are usually about six feet in diameter, and each heated with a fire below. The lead from the smelting furnace is treated as above in the middle pot, from which the poorer crystallized portion is ladled with a strainer into the first pot on the right, and the richer portion, which remains liquid, is removed to the first pot on the left. With both kinds the process is several times repeated—the one becoming poorer and the other richer in silver every time, till the lead in the pot on the extreme right, has had its silver almost entirely removed, and that in the pot on the extreme left, contains about three hundred ounces of silver to the ton. The silver is then obtained from this rich lead, by melting it on a flat bone-ash *cupel* (or cup for purifying metals), placed in a reverberatory furnace (where flame is reverberated or driven back upon matter to be melted), and exposing it to a current of air which reduces the lead to the oxide, or litharge of commerce, leaving the silver on the cupel. Nearly six hundred thousand ounces of silver are in this way annually separated from British lead, the latter at the same time being by the operation much improved in quality.

There are valuable lead mines in Spain, situated in Andalusia. The mountains of Granada yield a large supply. The great silver and lead mines of the Sierra de Almagrera, in Spain, of extraordinary richness, were almost accidentally discovered by a few humble individuals with very small means. They first tried some old mine-workings of the Romans with little success, but by persevering, and trying in other directions, at last struck the present wonderful deposit, which appears to have been unknown to the ancients. To show how little the early discoverers were aware of the importance of the discovery, the first cottages in which they lived were built of extremely rich and valuable mineral, thus realizing the old fables of silver houses in fairy-land.

A great number of the shareholders in the first instance were Spaniards—most of them men of small means,—and some large fortunes were made by men in the lowest grades of society. A peasant had taken a share, for which he paid a few dollars. These being expended, the manager of the mine called upon him for a further payment to defray expenses. To this the man demurred, when a neighbour said, "This mule of mine is about the value of your share and the money they now require; take it, and give me your ticket." This was agreed to, and the holder of the ticket, a few months afterwards, sold one-half of his prize for nine thousand pounds! Other instances of sudden wealth were very common.

There are lead mines in Hungary of great interest from their antiquity. In one of these, called "Felso Banya," an accident occurred that almost proved fatal to Baron Borro, one of the most intelligent and earliest writers on Hungarian science and natural history. The ore is arsenical, and of an extremely poisonous nature. It was in former times the practice to apply heat to render the work of removing the ore more easy. Descending on one occasion into the mine, somewhat too soon after an operation of this kind had been performed, the baron was almost suffocated by the arsenical vapours, and his constitution received a shock from which he never afterwards recovered. "I lost my senses," says the baron, "and fifteen hours afterwards I was restored to myself by blisters and other applications. My lips were swollen, my eyes ran with blood, and my limbs were benumbed. Violent coughing and acute pains in the loins followed, and seemed more than sufficient to destroy this thinly-framed machine."

The poisonous properties of lead are well known, and should be carefully guarded against. Persons whose system becomes impregnated with lead—as, for example, painters, who are constantly handling white lead, or persons who, for a length of time, have been using water charged with a lead salt—partake, in a more or less degree, of lead poison. This frequently produces colic, rheumatism, and palsy, or paralysis, and sometimes disease of the brain. Persons exposed, from their occupations, to the risk of lead poisoning should be especially attentive to cleanliness, and if they combine the use of the warm bath with drinking sulphuric lemonade, they may escape the effects of this metallic poison.

I must not conclude my notice of lead without some allusion to an article with which we are all familiar, under the popular name of a *lead* pencil. The truth is, however, that the metal which I have been describing does not enter into the composition of the pencil, so the term can have no other foundation than the lead colour which it imparts when traced upon paper.

The material used for pencils is called by mineralogists *graphite*, from a Greek word signifying "to write." It is a mineral consisting of carbon, or charcoal, with a very small mixture of iron. It is of a greyish-black colour, is soft and greasy to the touch, and stains the fingers with a lead-grey hue. It is a perfect conductor of electricity. The black-lead used for domestic purposes contains only a small portion of true graphite, and stoves are blackened with this material because it radiates heat more freely than any other known substance. Graphite is found chiefly in primitive rocks, and in the coal formations; it is obtained in crystals, but is generally massive. It is discovered in India, Greenland, Mexico, America, Norway, Germany, Spain, and other localities. The best substitute for Cumberland graphite is that of Bohemia and Bavaria, but the purest and most valuable quality is obtained in Cumberland.

In the clay slate of Borrowdale is a bed of greenstone rock, and in this is the graphite; but there is great uncertainty in finding it. At one time a mass was discovered lying along like a mighty tree, the thickest part being of the finest quality, and the other part wearing poorer until it was not worthy even to clean stoves. At other times the searchers have been altogether at fault for a long time together, and the mine has occasionally been closed from this cause. There was a time when the value of this graphite was so little known that the shepherds used it freely to mark their sheep; some time after, the proprietors were obtaining from thirty to forty shillings a pound for the graphite of one single deposit, which yielded upwards of twenty-eight tons. At that time houses were built at the entrance of the mine, where the miners were obliged to change their clothes under inspection, lest they should be tempted to carry away any of the precious stuff in their pockets.

The great scarcity of the pure mineral, and its high price, made it, according to Dr. Ure, "so common a subject of robbery about a century ago, as to have enriched, it is said, a great many persons living in the neighbourhood. Even the guard stationed over it by the proprietors was of little avail against men infuriated with the love oi plunder; since in those days a body of miners broke into the mine by main force, and held possession of it for a considerable time. The treasure is now protected by a strong building, consisting of four rooms upon the ground-floor; and immediately under one of them is the opening, secured by a trap-door, through which alone workmen can enter the interior of the mountain. In this apartment, called the dressing-room, the miners change their ordinary clothes for their working dress as they come in, and after their six hours' work they again change their dress under the superintendence of the steward, before they are suffered to go out. In the innermost of the four rooms two men are seated at a large table sorting and dressing the mineral, who are locked in while at work, and watched by the steward from an adjoining room, who is armed with two loaded blunderbusses. Such formidable apparatus of security is deemed requisite to check the pilfering spirit of the Cumberland mountaineers."

The cleansed black-lead is packed up into strong casks and sent to London, where it is sold at a monthly auction. The produce of six weeks' annual working of these mines is said to have been from thirty to forty thousand pounds. The Borrowdale mine is said to be almost exhausted, having, until lately, supplied most of the materials for English pencils. It is about halfway up a mountain two thousand feet high, somewhat difficult of access. A material for pencils is very much used, especially in France, made of graphite mixed up with very fine clay. The best pencils are, of course, made of the best graphite; the worst kinds are made with the powder which results from the sawing, mixed up into a paste with sulphur, gum, &c.

A case occurred some years ago in which a curious use was made of pencils. A great number of forged notes of the Bank of Russia got into circulation in that country by some means unknown. At length, information was given by the Russian Government to the custom-house authorities at the port of Cronstadt, that a certain vessel would shortly arrive from England with a miscellaneous cargo, including several gross of black-lead pencils; these, on arrival, were to be broken. In due time the vessel arrived, the box of pencils was landed, and on being opened, each pencil was found to contain a bank note tightly rolled up. The pencils had black-lead at each end, bore the stamp of a maker, and in all respects were so like ordinary pencils that no suspicion could have arisen without warning having been given.

CHAPTER XV.

DIAMOND MINES AND CELEBRATED DIAMONDS.

You will naturally inquire where diamonds are found, and your thoughts will probably wander over many wonderful stories of diamond finding, especially that of Sinbad the Sailor, in the "Arabian Nights' Entertainments," whose adventures in the valley of jewels are so amusing. However improbable the story, it is supposed to have originated from a fable long current in India, and which is thus related by Marco Polo, a Venetian traveller, an account of whose voyages was written in 1298. Speaking of India, he says:—"In the summer the inhabitants of Golconda ascend the mountains with great fatigue, as well as with considerable danger, from the number of snakes with which they are infested. Near to the summit, it is said, there are deep valleys full of caverns, and surrounded by precipices, amongst which the diamonds are found; and here many eagles and white storks, attracted by the snakes on which they feed, are accustomed to make their nests. The persons who are in quest of diamonds take their stand near the mouth of the caverns, and from thence cast down several pieces of flesh, which the eagles and storks pursue into the valleys, and carry off with them to the tops of the rocks. Thither the men immediately ascend, drive the birds away, and recovering the pieces of meat, frequently find diamonds sticking to them."

I must tell you, however, that Marco Polo, though a remarkably active and intelligent traveller, was a very credulous one, and easily imposed upon, and in this instance he certainly must have been duped.

The two principal countries where diamond mines, or rather *districts*, are chiefly found, are India and Brazil. They are also found in Malacca, Borneo, and other parts of the East; and America, Algiers, Australia, and Russia. The mines consist, in general, of mere diggings and washings of the mud of rivers.

The richness of the Golconda mines has long been proverbial, and it is from this source that the most remarkable diamonds have been obtained. The gems, however, are merely cut and polished at that place, being found near the southern frontier of the Nizam's, or sovereign's dominions. In all the Indian diamond soils the stones are so dispersed that they are rarely found directly, even in searching the richest spots, because they are enveloped in an earthy crust, which must be removed before they are seen. The loose earth containing diamonds lies always a little way beneath the surface of the soil, towards the lower outlet of broad valleys, rather than upon the ridges of the adjoining hills.

The first diamonds that were known to the traders in precious stones in Europe were brought from *Visapoor* and *Golconda*. The discovery of the mine in the latter place is attributed to a poor shepherd, who, while tending his flocks, stumbled on what appeared to him a pretty pebble. This stone he gave in exchange for some rice, to a man as poor as himself. After passing through several hands it fell into those of a merchant, who knew its worth, and who, after diligent search, succeeded in finding the mine. Having made excavations he found a reddish earth, mixed with pebbles, and intersected by white and yellow veins resembling lime.

Tavernier, an eminent French traveller of the seven teenth century, supposed that he was the first European that had visited the mines of Golconda; but he was mistaken. An Englishman, of the name of Methold, had been there before him, in 1622, and found thirty thousand labourers at work in the mine he visited, and which he stated to be but two leagues from the capital. It was then leased by the Government to one Marcandar, a rich merchant jeweller, who divided the soil in which the diamonds were supposed to be found into square lots, which he rented to other merchants. All stones weighing more than two carats (eight grains) were reserved for the king. Severe punishments were inflicted on whosoever attempted to defraud the sovereign of his dues, but these did not prevent a quantity of fine diamonds from being abstracted.

Tavernier describes a visit he paid to *Raolconde*, the principal mine of Golconda. "A very pretty sight is that presented every morning by the children of the master miners and of other inhabitants of the district. The boys—the eldest of whom is not yet over sixteen, or the youngest under ten years of age—assemble, and sit under a large tree in the public square of the village. Each has his diamond weight in a bag, hung on one side of his girdle, and on the other a purse, containing, sometimes, as much as five or six hundred pagodas. Here they wait for such persons as have diamonds to sell, either from the vicinity, or from any other mine. When a diamond is brought to them it is immediately handed to the eldest boy, who is tacitly acknowledged as the head of this little band. By him it is carefully examined, and then passed to his next neighbour, who, having also inspected it, gives it to the next boy. The diamond is thus passed from hand to hand amidst unbroken silence, until it returns to that of the eldest, who then asks the price and makes the bargain. If the eldest boy is thought by his comrades to have given too high a price he must keep the stone on his own account. In the evening the children take an account of their stock, examine their purchases, and class the diamonds according to their water, size, and purity, putting on each stone the price they expect to get for it. They then return the stones to their masters, who have always assortments of diamonds to complete, and the profits are divided among the young traders, a somewhat larger portion being given to the eldest. These children are so perfectly acquainted with the value of all sorts of gems, that if one of them, after buying a stone, is willing to lose one-half per cent. upon it, a companion is always ready to take it."

This singular custom, which was practised nearly two hundred years ago, shows the cleverness of the Indian youth at that period. The diamond mines of *Brazil* were discovered by a curious circumstance, in 1730. Some miners in searching for gold found some curious pebbles, which they carried home to their masters as curiosities. Not being considered of any value, they were given to the children to play with. An officer who had spent some years in the East Indies saw these pebbles, and sent a handful to a friend in Lisbon to be examined. *They proved to be diamonds.* A few were collected and sent to Holland, and were pronounced to be equal to those of Golconda. The news soon reached Brazil, and those who possessed any of the "pebbles" soon realized large sums of money. The Portuguese Government laid a claim upon all diamonds that might be found thereafter, and a search was made, and mines discovered.

Monsieur Castlenau gives some interesting particulars of the diamond seekers of Brazil. "Gold and diamonds, which in these regions, as in many others, are always found united, are gathered more especially in the numerous streams that traverse it, and even in all the extent of its soil. After the rains the children of the city of Diamantino seek for gold in the soil of the streets, and in the river Ouro that runs through it, and sometimes they pick up the value of eight to fifteen grains. As to diamonds, a negro is reported to have found one of nine carats among the roots of some vegetables which he pulled up in his garden. Diamonds have been sometimes found in the crops of chickens. The extraction of these precious gems is carried on in a very simple manner. In the season of low waters the negroes plunge and bring up from the bed of the stream the mud, which is removed to a convenient spot on the banks for working. The process is as follows:—A hut is erected about a hundred feet long, and half that distance in width; down the middle of the area is conveyed a canal covered with earth; on the other side of the area is a flooring of planks, about sixteen feet in width, extending the whole length of the shed, and to which an inclined direction is given. This flooring is divided into troughs, in which is thrown a portion of the river mud; the water is then let in, and the earth raked until the water becomes clear. The earthy particles having been washed away, the gravel is raked up to the extremity of the trough; the largest stones are thrown out, and afterwards the smaller ones; the whole is then examined with great care for diamonds. When a negro finds one, he claps his hands, and stands up, holding the diamond between his finger and thumb. It is received by one of the overseers, posted on lofty seats, at equal distances, along the line of work. On the conclusion of the work the diamonds found during the day are registered by the head overseer. If a negro has the good fortune to find a stone weighing upwards of sixty grains, he is made a free man; for smaller stones, proportionate rewards are given. These men are strictly watched while at their work, and severely punished when they are detected in stealing any diamonds, but for all this they manage to purloin half of the produce."

When diamonds were discovered in Brazil, the Portuguese fleet brought in one year more than seventy pounds weight of diamonds from that country to Europe.

The Sincora diamond mine in Bahia, a province of Brazil, was discovered in 1843, by a mulatto miner, who had previously been engaged at the mine of Surua, in the same province. On leaving Surua, he proceeded into the interior of the country alone, and with but fourteen days' provisions, in search of other washings, which he succeeded in finding in a few days. After labouring with success for some days, he found that his provisions were barely sufficient to carry him back to his home. He was therefore obliged to relinquish his labours, and return with the stones he had collected, which he offered for sale to some of the parties who had been engaged at the Surua mine. As the stones were of a different quality and shape to any they had seen before, they taxed him with having discovered a new mine. For some time he strongly denied having done so, but on being thrown into prison, and accused of having stolen the diamonds, he confessed his discovery, and on promise of making it known, was released. Six or eight months after, from ten to fifteen thousand persons had collected on the spot. The production of diamonds was so abundant that for the first two years it is supposed nearly six hundred thousand carats were extracted and forwarded to Europe.

"All is not gold that glitters," as we have before remarked, so it is with regard to diamonds. Mr. Mawe, in his "Travels through the Brazils," gives an amusing instance of a curious deception in this respect. A free negro wrote to the Prince Regent that he possessed a diamond so enormous that he begged to be allowed to show it in person to the prince himself. Believing in the accuracy of the man's statement, a carriage and an escort of attendants were sent to bring the fortunate prize-holder to court. The negro prostrated himself in the royal presence, and displayed the precious stone, which weighed nearly a *pound*, to the amazement and surprise of the prince. Conjectures were made as to the value of this presumed diamond, which was supposed to be worth several millions. It was sent to the royal treasury with a strong escort, and deposited in the hall of gems. Some doubt, however, of the stone being a real diamond, seems to have been entertained by a few persons at court, and Mr. Mawe happening to be at Rio de Janeiro at the time, he was requested to examine the stone, being a distinguished mineralogist. He went to the treasury, proceeded through several magnificent apartments, and crossed a great hall hung with crimson and gold, in which was a statue of natural size, representing Justice with her scales. At length he came to a room in which were several chests; three officers, each having a key, opened one of these chests, and the treasurer produced the stone. Mr. Mawe, at a glance, saw that it was nothing but a piece of rounded crystal, and proved it by scratching it with a real diamond. What had been supposed to be worth millions, turned out to be of no value whatever. The negro, who had been escorted to court with such pomp, had to trudge back home on foot.

Notwithstanding the great rarity and value of the diamond, it is (as I have before stated) only carbon, or charcoal in its purest state, and can be consumed by fire at a heat less than that required for melting silver. By what process nature has concentrated and crystallized the substance has never been discovered. Numerous attempts have been made to obtain diamonds artificially, and, according to some accounts, not altogether without success, although those obtained have been so exceedingly small as to be of no use. It is the hardest of all known substances, the purest and most brilliant of all gems. It is found of various colours, blue, red, yellow, green, brown, grey, and even black; with the exception of the latter, however, all these shades are light and pale.

The diamond is found always crystallized, and in its rough state the surface is often dull and uneven, and although known from the earliest ages, the ancients were totally unacquainted with the mode of cutting and polishing it; even in the time of Charlemagne the process was unknown, as the clasps of that monarch's mantle, still preserved in Paris, have four large diamonds in their rough state. The diamonds worn by St. Louis, King of France, in the thirteenth century, are said to have been uncut. You will perhaps wonder at this, but the great difficulty of cutting diamonds arises from their extreme hardness, and no other mineral having the power of scratching them, thus the name is derived from a Greek word signifying "unsubdued." To cut and polish the diamond it is necessary, therefore, to use the powder of other diamonds.

This was discovered in 1476 by Louis de Berquem, a young man of Bruges, who, having observed the effect produced by rubbing one diamond against another, conceived the idea of using diamond-dust, and thus was the first diamond polished in Europe by him.

Diamonds are now cut, at least in Europe, in three principal forms, called the *table*, the *rose*, and the *brilliant*, the first being the least, and the last the most advantageous for the production of that splendid play of colours for which the diamond is esteemed. The forms depend upon the shape of the rough stone; if this should be flat, the table, or rose form, is given, but if it should be thick, it admits of the brilliant.

In cutting diamonds from the rough, the process is so uncertain that the workmen think themselves fortunate in retaining one-half of the original weight. The Koh-i-noor diamond, when first presented to our Queen, was merely surface-cut, no attempt having been made to produce the regular form of a brilliant.

The process of diamond-cutting is effected by a level iron plate, of about ten inches diameter, called a *mill*, which turns from two thousand to three thousand times each minute. The diamond is fixed in a ball of pewter at the end of an arm resting upon the table in which the iron plate turns; the other end, at which the ball containing the diamond is fixed, is pressed upon the wheel by moveable weights, at the discretion of the workman.

The recutting of the Koh-i-noor diamond, which was commenced July 16, 1852, occupied thirty-eight days, working twelve hours daily without cessation. The late Duke of Wellington was the first person who placed the diamond on the mill for that purpose.

I may explain to you that the term *carat* is said to be derived from the name of a bean, the produce of a tree called "kuara," a native of Africa, and signifying "sun" in the language of the country, because it bears flowers and fruit of a flame colour. As the seeds of this pod are always of nearly uniform weight, the natives have used them, from time immemorial, to weigh gold. The beans were transported into India at an ancient period, and have been long employed there to weigh diamonds. The carat is, in fact, an imaginary weight, consisting of four nominal grains, a little lighter than four grains troy.

I will briefly notice some of the most celebrated diamonds that are known for their size, or from the historic interest connected with them. There are but few diamonds in the world that exceed a hundred carats in weight. The largest known belongs to the Rajah of Mattan, in the East Indies. It is of the purest water, and weighs three hundred and sixty-seven carats. In shape it is like an egg, with an indented hollow at the smaller end. It was discovered at Landak about one hundred and twenty years ago, and although the possession of it has cost several wars, it has remained in the royal family of Mattan more than a century. You will be surprised, no doubt, that the possession of a diamond should occasion wars, but such has been the case, not only in this, but in other instances. This jewel has roused some of the worst passions in human nature; envy and covetousness have led to murders and crimes, and men have rushed on destruction to obtain the glittering prize that cannot make them wiser or happier. A governor of Batavia, the capital of the Dutch possessions in the East Indies, wished to become the purchaser of the Mattan diamond, and offered one hundred and fifty thousand dollars for it, besides two war brigs with their guns and ammunition, together with a great number of guns, and a quantity of powder and shot. But this offer was refused, for the diamond was celebrated throughout India for a miraculous power it was said to possess for curing every kind of disease, by means of the water in which it was steeped. This was a foolish superstition, but the Rajah himself believed that if he parted with a jewel so precious, some evil would happen to himself or his family.

The next in point of size is the magnificent *Koh-i-noor*, or Mountain of Light, diamond, belonging to the English Crown, and exhibited at the Crystal Palace in Hyde Park, in 1851. A singular interest is attached to this jewel, which was discovered in the mines of Golconda, and remained in the possession of the rulers of that country until the time of the father of the famous Emperor Aurungzebe, who having conquered its owner, took the splendid gem also.

While the Koh-i-noor was in the hands of the Moguls it was first seen by Tavernier, a French traveller, in 1665. This gentleman was permitted by Aurungzebe, as an act of indulgence, to examine the diamond closely, and from the account he gave, it became known to the European world as the diamond of the great Mogul. In this interview the emperor is described as being seated on a throne of state, while the chief keeper of his jewels produced his treasures for inspection on two golden dishes. The magnificence of the collection was indescribable, but conspicuous above all, in lustre, esteem, and value, was the Koh-i-noor.

I may here remark that in the royal cabinet at Dresden there is a representation of Aurungzebe on his throne, a piece comprising one hundred and thirty different figures in enamelled gold. This work is said to have occupied the celebrated artist Dinglinger and his family and fourteen assistants no less than eight years.

The Koh-i-noor, sometimes worn on the person of the Moguls, or adorning their famous peacock throne, was safely preserved at Delhi, until, in 1739, the empire was overrun by the Persians under Nadir Shah. Together with the spoils of conquest (estimated at ninety millions sterling), the great diamond was transferred to Khorassan. Nadir Shah, however, was killed by his subjects, and the jewel was carried away by a party of Affghan soldiers under Ahmed Shah, to their own country. It seems as if the Koh-i-noor carried with it the sovereignty of India, for the conquests of Ahmed gave him the control of Hindostan. In his family the diamond remained until the year 1800, when its then owner, Zemaun Shah, was overthrown by Shah Shuja and imprisoned. But the usurper on ascending the throne could not find the precious jewel; the treasury at Cabul was searched in vain, until at last it was found ingeniously secreted in the prison wall of the dethroned monarch. Eight years afterwards the Shah Shuja had become so powerful that the British Government sent Mr. Elphinstone as ambassador to his court, for the purpose of maintaining friendly relations. At the audience given to the ambassador, Shah Shuja appeared, magnificently arrayed in a green tunic, glittering with gold and precious stones, and wearing the Koh-i-noor in a bracelet upon his right arm. This was a second time that a European had been favoured with a sight of it, one hundred and forty-three years having elapsed since its exhibition to Tavernier. Hardly, however, had Mr. Elphinstone left the court, when the Shah was expelled from Cabul, carrying away the far-famed diamond concealed on his person. After many adventures he at length found refuge among the Sikhs. Runjeet Singh, the chieftain, was fully able to protect or to give up the exile, but he knew, or suspected, that the Koh-i-noor was in his possession. He put the Shah under strict watchers, and then made a formal demand for the jewel. The Shah hesitated, prevaricated, and made every effort to evade the matter, but Runjeet was resolute, and a day was at length fixed upon for the surrender of the diamond. This was in 1813. The two princes met in a room appointed for the purpose, and took their seats upon the ground. A solemn silence then ensued, which continued unbroken for an hour. At length Runjeet's impatience could not be controlled, and he quickened the memory of the Shah. The exiled prince spoke not a word in reply, but calmly motioned to an attendant, who produced a small roll which he placed midway between the two chiefs. Again a pause ensued, when, at a signal from Runjeet, the roll was unfolded, and the glittering Koh-i-noor passed into his possession. This diamond was afterwards worn by Runjeet Singh as an armlet, and was considered in itself an ornament of such extraordinary value as to allow the wearer to dispense with the decoration of many other jewels. The Hon. W. G. Osborne, describing a visit to the hall of audience of this potentate, says, "The whole place behind the throne was crowded with Runjeet's chiefs, mingled with natives from Candahar, Cabul, and Afghanistan, blazing with gold and jewels, and dressed and armed in every conceivable variety of colour and fashion. Cross-legged, in a golden chair, sat Runjeet Singh, dressed in simple white, wearing no ornaments but a single string of enormous pearls round the waist, and the celebrated Koh-i-noor, or Mountain of Light, on his arm."

This diamond, in common with many other jewels of great price, were used to adorn the favourite horses of this prince. The Hon. Miss Eden states "that the jewelled trappings of the horses were of the most costly description, being chiefly emeralds of immense size and value, hanging around the neck, covering the forehead, and fastened on the front of the saddle. The jewels and ornaments were said to be worth three thousand pounds." Sometimes the horses were honoured with the addition of the Koh-i-noor. With great kindness the prince sent this diamond, with other jewels, to the camp of the governor-general for the inspection of the ladies, and thus Miss Eden was able, from actual measurement, to make a drawing of the Koh-i-noor at a time when there was no reason to suppose it would ever make its appearance in this country. On the annexation of the Punjab, however, it was given up to the East India Company for the Queen of England, and was brought over to London in 1850. For a few years previous to this the Koh-i-noor had formed a part of the decorations of a hideous idol kept at Orissa.

The loss of the diamond is regarded by the superstitious natives of India as the downfall of their supremacy. How many ages have elapsed since the Koh-i-noor was found in the mines at Golconda no one can tell, but the Hindoos, who are fond of exaggerated numbers, say that it belonged to Kama, a king of Auga, three thousand years ago. This is of course a tradition only, but the first discovery of the jewel belongs to very early times. When first given to Shah Jehaun the Koh-i-noor was still uncut, weighing, it is said, in that rough state nearly three hundred carats, which were reduced by the person employed to cut it, by his unskilful treatment, to two hundred and seventy-nine carats. The workman, a Venetian, instead of being rewarded for his labour, was fined a large sum of money by the enraged Mogul, and was probably glad enough to escape with his head safe on his shoulders. After the arrival of the Koh-i-noor in England, to improve its brilliancy it was recut, by which its weight was reduced one-third. As exhibited at the Crystal Palace in 1851 the diamond weighed over one hundred and eighty-six carats.

As to the *value* of the Koh-i-noor, guesses have varied from half a million to three millions and a half sterling, showing how vague are all attempts to estimate such rarities, and, after all, the *chemical* value of diamonds is only equal to that of a similar weight of pure charcoal of which, as I before mentioned, they consist. Mr.

Tennant observes, that to express the value of an ounce of coal we have no coin sufficiently small. It is the same with iron and lead, metals of inestimable importance. An ounce of copper may be worth a penny, an ounce of silver may be worth five shillings, an ounce of pure gold four pounds; but the very refuse of the diamond—that which is only used for the purpose of breaking up into small particles for cutting other stones —is worth *fifty pounds an ounce!*

A magnificent diamond, belonging to the Emperor of Russia, bought by the Empress Catherine, weighs over one hundred and ninety-three carats. It is said to be the size of a pigeon's head, and to have been purchased for ninety thousand pounds, besides a yearly sum for life to the Greek merchant who sold it for four thousand pounds. It is reported that this diamond formed one of the eyes of the famous idol Juggernaut, whose temple is on the Coromandel coast, and that a French soldier, who had deserted into the Malabar service, found the means of robbing the temple of it, and escaped with it to Madras, where he disposed of it to a ship captain for two thousand pounds, by whom it was resold to a Jew for twelve thousand pounds. From him it was transferred for a large sum to the Greek merchant. This diamond now surmounts the imperial sceptre.

The diamond of the Emperor of Austria, which formerly belonged to the Grand Dukes of Tuscany, weighs one hundred and thirty-nine and a half carats. Its estimated value is one hundred and fifty-five thousand pounds. This stone is of a lemon-yellow colour, which greatly lessens its value.

Among the Prussian crown jewels is the famous *Regent* or *Pitt* diamond, discovered in the Pasteal mine at Golconda. It weighs one hundred and thirty-six and three-quarters carats, and is remarkable for its form and clearness, which have caused it to be valued at one hundred and sixty thousand pounds, although it cost only one hundred thousand pounds. It was stolen from the mine and sold to Mr. Pitt, grandfather of the great Earl of Chatham. The Duke of Orleans purchased the diamond, for presentation to King Louis the Fifteenth. Madame de Barrera informs us, that "when, after the fall of Louis the Sixteenth, the people insisted that the beautiful works of art and nature hitherto reserved for the enjoyment of the refined and educated should be exposed to the gaze of the mob, the Regent diamond was paraded. So little, however, did the exhibitors confide in the integrity of these patriots that great precautions were taken to prevent the consequences of too strong an attraction. The passer-by, who chanced to demand, in the name of the sovereign people, a sight of the finest of the ex-tyrant's (as King Louis was called) jewels, entered a small room, within which, through a little wicket, the diamond was presented for sight. It was fastened by a strong steel clasp to an iron chain, the other end of which was secured within the aperture through which it was handed to the spectator. Two policemen kept a vigilant watch on the momentary possessor of the gem, until, having held in his hand the value of twelve millions of francs, according to the estimate in the inventory of the crown jewels, he again took up his hook and basket at the door and disappeared."

This diamond, which decorated the hilt of the sword of state of the first Napoleon, was taken by the Prussians at Waterloo, and now belongs to the King of Prussia.

The largest diamond furnished by Brazil, now in possession of the crown of Portugal, weighs one hundred and twenty carats.

The *Sanci* diamond, supposed to have been the first that was cut and polished in Europe, has a curious history attached to it. It is said to have belonged formerly to Charles the Bold, Duke of Burgundy, who wore it in his hat at the battle of Nancy, where his army was completely defeated, and where he lost his life in 1477. It was found on the field of battle by a Swiss soldier, who sold it to a French gentleman of the name of Sanci. The diamond was preserved in his family for nearly a century, until Henry III. commissioned a descendant of the original purchaser, and who was a captain of Swiss troops in his service, to raise fresh recruits among the Swiss. King Henry, driven from his throne by a league against him formed by his subjects, and without money to pay his troops, borrowed the Sanci diamond in order to pawn it to the Swiss. Sanci ordered one of his servants to take it to its destination, but both the man and the diamond disappeared, and for a time all trace of them was lost. It seems, however, that Sanci had great faith in the honesty of his servant, and determined to make a search for him. At length he discovered that the man had been assassinated by robbers, and the body had been buried in a neighbouring forest. Thither he went, and ordered the body to be disinterred and opened, when the diamond was discovered in his stomach, the faithful servant having swallowed it to conceal the precious gem from the robbers.

This diamond came into the possession of the English crown; and James II., when forced to leave the country, took it with him to France in 1688. Louis XV. wore it at his coronation. In 1835 it was purchased by a Russian nobleman for eighty thousand pounds.

In 1786 a very valuable diamond, of unusual size and brilliancy, was presented to George III. by Warren Hastings (who had been Governor of India) as a gift from the Nizam, or ruler of the Deccan in India. As Hastings was then about to be put on his trial for alleged offences committed by him in India this present was looked upon as a bribe, and caricatures appeared, one representing Hastings wheeling the king in a barrow to market, and saying, "What a man buys he may sell again." In another the king was represented in a kneeling posture, with his mouth open, and Hastings throwing diamonds into it.

In former times, superstition attributed to the diamond many virtues. It was supposed to protect the possessor from poison, pestilence, panic-fear, and enchantments of every kind. A wonderful property was also ascribed to it when the figure of Mars, whom the ancients represented as the god of war, was engraved upon it. In such cases the diamond was believed to insure victory in battle to its fortunate owner, whatever might be the number of his enemies.

For a long time diamonds were sent to Holland to be cut and polished, but no workmen now succeed better in this art than our own.

Diamonds are not only worn as ornaments of dress, or rare objects of art, but they are employed for several useful purposes, as for cutting glass by the glazier, and all kinds of hard stones by the lapidary. The portion of the precious jewel that is usually employed for a "glazier's diamond" seldom exceeds one-twentieth part of a grain. It is carefully set in a brass socket at the lower end of a wooden handle, so hollowed out as to receive the ball of the thumb and the balls of the first and second finger, by which it is steadily held in an upright position, that the brass socket may present the edge of the diamond at the proper angle to cut the glass.

Diamond dust is very useful for polishing other precious stones, as well as for engraving on them. An instrument for boring into hard rock has been employed in France, made out of a tube furnished with a circular cutter of rough diamonds. It is caused to revolve, and as it enters into the stone, the cutter scoops out a cylinder, which is afterwards easily taken out of the tube. Holes in hard granite, for blasting purposes, are thus bored in one hour, which would have required two days' work in the ordinary way. The diamonds, when examined through a magnifying glass, do not seem at all injured by the process.

In concluding my remarks on diamonds I will give you an account (as related by Professor Tennant) of the jewels that compose the imperial crown of England. The state crown of her Majesty was made by Messrs. Rundell and Bridge, in 1838, with jewels taken from old crowns, and others furnished by command of the Queen. It consists of diamonds, pearls, rubies, sapphires, and emeralds, set in silver and gold; it has a crimson velvet cap with ermine border, and is lined with white silk. Its gross weight is thirty-nine ounces five pennyweights troy. The lower part of the band, above the ermine border, consists of a row of one hundred and twenty-nine pearls, and the upper part of the band a row of one hundred and twelve pearls, between which, in front of the crown, is a large sapphire (partly drilled), purchased for the crown by George the Fourth. At the back is a sapphire of smaller size, and six other sapphires (three on each side), between which are eight emeralds. Above and below the several sapphires are fourteen diamonds, and around the eight emeralds, one hundred and twenty-eight diamonds. Between the emeralds and sapphires are sixteen trefoil ornaments, containing one hundred and sixty diamonds. Above the band are eight sapphires, surmounted by eight diamonds, between which are eight festoons, consisting of one hundred and forty-eight diamonds. In the front of the crown, and in the centre of a diamond Maltese cross, is the famous ruby said to have been given to Edward, Prince of Wales, son of Edward the Third, called the Black Prince, by Don Pedro, King of Castile, after the battle of Najera, near Vittoria, in 1367. This ruby was worn in the helmet of Henry the Fifth at the battle of Agincourt, 1415. It is pierced quite through after the Eastern custom, the upper part of the piercing being fitted up by a small ruby. Around this ruby, to form the cross, are seventy-five brilliant diamonds. Three other Maltese crosses, forming the two sides and back of the crown, have emerald centres, and contain each one hundred and thirty-two, one hundred and twenty-four, and one hundred and thirty brilliant diamonds. Between the four Maltese crosses are four ornaments in the form of the French fleur de lys, with four rubies in the centres, and surrounded by rose diamonds, containing respectively eighty-five, eighty-six, eighty-six, and eighty-seven rose diamonds. From the Maltese crosses issue four imperial arches, composed of oak leaves and acorns, the leaves containing seven hundred and twenty-eight rose, table, and brilliant diamonds, twenty-two pearls forming the acorns, set in cups containing fifty-four rose diamonds and one table diamond. The total number of diamonds in the arches and acorns is one hundred and eight brilliants one hundred and sixteen table, and five hundred and fifty-nine rose diamonds. From the upper part of the arches are suspended four large pendent pear-shaped pearls, with rose diamond caps, containing twelve rose diamonds, and stems containing twenty-four very small rose diamonds. Above the arch stands the mound, containing, in the lower hemisphere, three hundred and four brilliants, and in the upper, two hundred and forty-four brilliants; the zone and arc being composed of thirty-three rose diamonds. The cross on the summit has a rose-cut sapphire in the centre, surrounded by four large brilliants, and one hundred and eight smaller brilliants.

Total of the jewels comprised in the crown:—one large ruby, irregularly polished, one large broad-spread sapphire, sixteen sapphires, eleven emeralds, four rubies, *one thousand three hundred and sixty-three brilliant diamonds*, *one thousand two hundred and seventy-three rose diamonds*, *one hundred and forty-seven table diamonds*, four drop-shaped pearls, two hundred and seventy-three pearls.

CHAPTER XVI.

PRECIOUS STONES, AND SUPERSTITIONS CONNECTED WITH THEM.

> "Fiery opals, sapphires, amethysts,
> Jacinths, hard topaz, grass-green emeralds,
> Beauteous rubies, sparkling diamonds,
> And seld-seen costly stones of so great price,
> As one of them, indifferently rated,
> Might serve, in peril of calamity,
> To ransom great kings from captivity."
>
> MARLOW.

I HAVE, in the preceding chapter, given you some information respecting the "king of gems," the diamond. A few observations on some of the other precious stones may prove useful and interesting. The chemical value of these beautiful objects of luxury is but small, the diamond itself,—

> "Transparent image of eternal light,"

being, as I have mentioned, only charcoal or pure carbon; and the corundum, including the sapphire, ruby, girasole, topaz, emerald, amethyst, aquamarina, asteria, &c., being composed, almost exclusively, of crystallized clay tinged with iron, which has been called the great colourist of mineral nature; while the opal, the carnelian, the agate, the jasper, and the bloodstone are merely modifications of silex, or pure flint. Still, as objects of ornament, rarity, and value, precious stones have always been held in the highest estimation, and too often, I may add, of veneration.

In the holy Scriptures we have the earliest source of information respecting jewels. You will find in the Book of Exodus (chap. xxviii. 17—19) a particular description of the jewelled breastplate of Aaron, the high priest of the Jews. It consisted in a richly embroidered cloth, in which were set, in four rows, twelve precious stones, on each of which was engraved the name of one of the twelve tribes of Israel: these are distinguished as sardius (ruby), topaz, carbuncle, emerald, sapphire, diamond, ligure (jacinth), agate, amethyst, beryl, onyx, and jasper.

We have here, also, the first instance recorded of writing or engraving on precious stones. The Jews, in all probability, learnt this art from the Egyptians; the commandment prohibiting the representation of any animal or thing confined their skill to the engraving of names, &c., as seals.

In the sublime description of the heavenly Jerusalem (Rev. xxi. 11—21) the twelve foundations of the wall of the city were garnished with precious stones. You will see, therefore, from these and other passages in the Bible, that the mention of such objects was to convey conceptions of the greatest beauty and perfection; proving the high esteem in which jewels were held.

In the holy Scriptures we find also the earliest traces of superstitions with regard to charms, amulets, and other virtues that jewels were supposed to possess. The earrings mentioned by Isaiah (iii. 20) are believed to have denoted amulets, although they served also the purposes of ornament. They were probably precious stones, with sentences of the law, or magical inscriptions, worn in the ears, or suspended round the neck. For the same purpose were, no doubt, the pebbles and curious stones which are found in ancient British places of sepulture.

Superstitions, we are told,—

"Cling like the leech, tenacious to the last;"

and thus the same kind of charms are still used in the East. The Jews entertained many strange notions with regard to the mysterious influence of precious stones: one I will mention, as it was, no doubt, founded upon the jewelled breastplate of Aaron. They pretended to foretell future events by the change of colour, or brilliancy, on twelve precious stones, on which were engraved as many anagrams (a conceit arising from the letters of a name being transposed) of the name of God. In the Talmud (a book of Jewish traditions) it is stated that Noah derived all the light he had in the ark from precious stones.

Among the Greeks and Romans the most wonderful stories were also prevalent. Orpheus, in his poem on gems (supposed to have been written by an Asiatic Greek, in the fourth century), thus describes the cave of Hermes (the Greek name for Mercury, who was adored among other attributes as the god of commerce, gain, riches, and unexpected fortune):—

"That mystic cave, where the wise god, a hoard
Of all things good hath in his treasure stored:
He shall return, and bear in both his hands
A heap of blessings numerous as the sands.
No care or sorrow shall he ever taste,
No pining sickness his strong body waste;
Nor dreading his foes' might, from battle flee,
Abandoning the hope of victory;
Nor in the games when he disputes the prize
Shall e'er opponent dare 'gainst him to rise,

Though limbs of brass, though souls of iron they bring,
All burning for the crown, into the ring;
By mountain herds as the great lion feared,
And by his followers as a god revered.
In regal courts, he honour shall command,
And 'mid the people of each foreign land."

" A thousand other blessings heaped on high
Stored in the caves of skilful Hermes lie;
Immortal, true, of wondrous potency,
Who so attains a happy man as he?"

KING.

Pliny tells us it was the common belief in his time (the first century after the death of Jesus Christ), that the first individual who wore a ring with a stone upon it was Prometheus, who was condemned, for having deceived Jupiter, to carry on his finger, as a memorial of his offences, a piece of the rock of Caucasus, to which he had been enchained, set in a ring of iron. I must add, however, that Pliny, who was in considerable advance of the age in which he lived, discredited, very naturally, this fiction. The same writer mentions the celebrated jewel of Polycrates, the tyrant of Samos, as being considered so valuable that the opulent owner even imagined the loss of it would save him from any reverses that might happen, and accordingly he cast it into the sea. It was greedily swallowed by a large fish which was afterwards taken, and on being prepared for the royal table, the ring was discovered in his stomach, and returned to Polycrates, who ended his days miserably.

Pliny adds, that the precious stone thus strangely returned to its owner was a sardonyx, which was still preserved in his time at Rome.

You may, probably, have heard of the wonderful ring of Gyges, king of Lydia, who died 680 years before the birth of Christ. By means of this jewel it was pretended that the wearer could render himself invisible.

The ancients believed that there was a mysterious sympathy between what they termed the seven planets and seven precious stones. Thus the turquois had relation to *Saturn;* the carnelian, *Jupiter;* emerald, *Mars;* diamond, the *Sun;* amethyst, *Venus;* loadstone, *Mercury;* crystal, the *Moon.* You may consider these notions extremely silly, and so they are, but even at the present time the Poles entertain an idea that each month in the year is under the influence of a precious stone, and concerns the destiny of a person born in the respective month. On birthdays it is customary to make presents of trinkets, ornamented with natal stones. The following are the dedications and meaning of them:—January, the garnet, emblematic of constancy and fidelity; February, amethyst, sincerity; March, bloodstone, courage and presence of mind; April, diamond, innocence; May, emerald, success in love; June, agate, health and long life; July, carnelian, contented mind; August, sardonyx, conjugal fidelity; September, chrysolite, antidote against madness; October, opal, hope; November, topaz, fidelity; December, turquois, sincerity. The latter stone is also believed by the Germans to be a test of the constancy of affection, the permanence of its colour being indicative of the unchangeableness of the wearer. Probably Shakspere had in view the superstitions current in his time respecting the turquois, when he makes Shylock say "he would not have lost his turquois ring for a whole wilderness of monkeys." Even during the life of the illustrious Harvey (who, about 1615, is said to have been the first who promulgated the great theory of the circulation of the blood, which completely revolutionized the art of medicine) there were quacks in England, who pretended to cure all diseases by charms and magic. A writer of that period says, "A hundred to one if they have not a fling at the celestial stone, too, of Armenia, whereby they can cure a large catalogue of diseases."

Superstitions respecting precious stones have been handed down from the remotest times, and a few crop up occasionally among us, still to show how prone the mind is to err, even in days that discoveries in science may justly call enlightened.

The most striking similes derived from jewels, apart from the supernatural, are those which accompanied the present of Pope Innocent to king John of four costly rings. He begged the monarch to consider seriously the form of the rings, their number, their matter, and their colour. Their form, being round, shadowed forth eternity, which had neither beginning nor end; and he ought thence to learn his duty of aspiring from earthly objects to heavenly, from things temporal to things eternal. The number four, being a square, denoted steadiness of mind, not to be subverted either by adversity or prosperity, fixed for ever on the firm basis of the four cardinal virtues. Gold, which is the matter, being the most precious of metals, signified wisdom, which is the most precious of all accomplishments, and justly preferred by Solomon to riches, power, and all exterior attainments. The blue colour of the sapphire represented faith; the verdure of the emerald, hope; the redness of the ruby, charity; and the splendour of the topaz, good works. Well would it have been for king John if he had appreciated these precious words, as well as he, no doubt, did the jewels themselves; but you, my young readers, are sufficiently acquainted with history to know that the whole career of this depraved monarch was stained by duplicity, meanness, and selfishness.

From the regions of the East came the most fabulous stories respecting precious stones, and it is there, chiefly, at the present time, that superstitions of a similar character remain.

You are all acquainted with Aladdin's adventures in the wonderful garden of jewels; how the trees were loaded with pearls, diamonds, rubies, emeralds, turquoises, amethysts, and sapphires; and how he gathered a large quantity of what he then only considered to be pieces of coloured glass, but which proved to be gems of inestimable value. The "Book of the Thousand and One Nights" is full of allusions to similar mineral riches; especially in the adventures of Sindbad the Sailor, whose description of Serendib refers to the island of Ceylon, the "Taprobane" of the ancients:—

> "From India and the golden Chersonese
> And utmost Indian isle Taprobane."

The voyages of Arabian mariners during the Middle Ages, in the Indian seas, no doubt contributed most of the principal events related in the "Arabian Nights," and although enveloped in the fictions that the Oriental mind delights in, a basis of truth may be found in some of the scenes and descriptions. Ceylon, in particular, has been through many ages famous for its wealth in precious stones. It was anciently called the "resplendent," "a pearl upon the brow of India;" the Chinese knew it as the "island of jewels." The great amount of precious stones still found at Ceylon will account for the early traditions respecting them, making due allowance for flights of imagination, which all of us, old and young, know to be very deceptive. Most of the gems are derived from granite rocks. As it is necessary you should know where, and in what manner the precious stones are found, I will explain that granite, which is regarded as the most ancient of all known rocks, is composed of quartz, mica, and felspar, each crystallized and adhering to the other, but without any base or cement. These three ingredients are necessarily present in granite, but do not exclude others, more especially *hornblende*, which is of a black or dark green colour, heavier, but less hard than quartz or felspar; *quartz* is one of the hardest minerals of which mountain masses are formed, and is composed of flinty earth combined with a very small portion of clay; *mica* (from the Latin word, *micans*, glittering) consists of very thin leaves which may easily be separated with a knife, and the composition of which is flint, clay, oxide of iron, and some potash; *felspar* (a name derived from the German) is composed of thin plates, by which it may be generally distinguished from quartz; it has a shining lustre, and consists of flint, clay, potash, lime, and oxide of iron.

Although the precious stones are found in the beds of rivers in Ceylon, their true source are the surrounding rocks which I have described. The quality of the sand and mud in which they are found show that they have been washed away by heavy rains, with fragments of the rocks to which they belonged, and in which they had crystallized to the lower ground, or beds of the river. Thus nature aids the gem-seeker, by placing within his reach what could not otherwise be obtained.

The sources from whence the chief supplies of the Ceylon jewels are obtained, Sir James Emmerson

Tennant informs us, are the plains at the foot of the stupendous hills of Saffragam, in the deposits left by the action of rivers, floods, and torrents; but almost every valley in communication with the rocks of the higher ranges contains precious stones of more or less value, and the beds of the rivers flowing southwards from the mountain chain are rich in fragments of rubies, sapphires, and garnets.

Mr. Baker, in his work "The Rifle and the Hound in Ceylon," thus describes some of these enriched sands in the south-east extremity of the island :—"The sand was composed of mica, quartz, sapphire, ruby, and jacinth, but the larger proportion of ruby—sand was so extraordinary that it seemed to rival Sindbad's story of the vale of gems: the whole of this was valueless, but the appearance of the sand was very inviting as the shallow stream, in rippling over it, magnified the tiny gems into stones of some magnitude. I passed an hour in vainly searching for a ruby worth collecting, but the largest did not exceed the size of a mustard seed."

The manner in which the search is made for precious stones by the natives of Ceylon will afford you some interest. Ratnapoora, which means literally the "city of jewels," is in the district of Saffragam, and the principal seat of the gem "fishery." At an opening in the gay border of gigantic bamboos, with their elegant gold stems, and near a small tributary stream, is the chief treasure bed. Here the natives are to be seen up to their breasts in water working about with mattocks. They stand in an oblique line across the stream, and shovel up from its bed, against the current, all the mud in which the precious stones are contained. The presence of gems is indicated by the approximation in a yellow clay of the various descriptions of precious stones. The slime, or mud, being collected into heaps, and put into porous clay like baskets, the water, as it flows on, washes away the fine particles of silt or mud, leaving the coarse gravel. Every half-hour the men dip down, holding the flat baskets in their hands, which they swing backwards and forwards in the water with much exertion to separate the lighter particles, after which they carry them to the shore to be examined.

Some idea of the quantity of precious stones found at Ceylon may be gathered from the amount realized from their sale, which is stated at ten thousand pounds annually. Of these, one-fourth is probably purchased by the natives themselves; more than one-half is sent to the continent of India, and the remainder is exported to Europe.

I think you will agree with me, however, that this appears a small compensation for the comparative poverty of the useful metals in Ceylon, the true value and importance of which I have endeavoured to set before you in the previous chapters of this book. Still, the wonderful gifts of Providence are widely diffused, and if we had the eye "divine" to perceive them, we should understand how everything is ordered and arranged on the best and wisest plan for the good of mankind, and lift our thoughts to Him—

> "Who, not content
> With every food of life to nourish man,
> By kind illusions of the wondering sense
> Has made all nature beauty to his eyes,
> Or music to his ear."

Mr. Crawford, in his "Journal of an Embassy to the Court of Ava," gives a description of the ruby and sapphire mines of Pegu and Ava. "The precious stones ascertained to exist in the Burmese territory are chiefly those of the sapphire family and the spinel ruby. They are found at two places, not very distant from each other, called Mogaut and Kyatpean, about five days' journey from the capital, in an E.S.E. direction. From what I could learn, the gems are not obtained by any regular mining operations, but by digging and washing the gravel in the beds of rivulets and small brooks. All the varieties of the sapphire, as well as the spinel, are found together, and along with them large quantities of corundum. The varieties ascertained to exist are the Oriental sapphire, the Oriental ruby or redstone, the opalescent ruby or cat's-eye ruby, the star ruby, the green, the yellow, and the white sapphires, and the Oriental amethyst. The common sapphire is by far the most frequent, but, in comparison with the ruby, is very little prized by the Burmese, in which they agree with other nations. I brought with me several of great size, the largest weighing no less than 3,630 grains, or about 907 carats. The spinel ruby is not unfrequent in Ava, but is not much valued by the natives. I brought with me to England a perfect specimen, both as to colour and freedom from flaws, weighing twenty-two carats. The sapphire and ruby mines are considered the property of the king; at least, he lays claim to all stones that exceed a certain weight. The miners, it appears, endeavour to evade this by breaking the large stones into fragments. In the royal treasury there are, notwithstanding, many fine stones of both descriptions. The year before our visit, the king received from the miners a ruby weighing one hundred and twenty-four grains, and the year preceding that eight good ones, but of smaller size. No stranger is permitted to visit the mines; even the Chinese and Mahommedans residing at Ava are carefully excluded."

The ancients never attempted any scientific classification of the mineral substances they were acquainted with. They appear to have distinguished precious and other stones only by colour, weight, and solidity. The names of minerals used by different authors in a confused manner, renders it impossible to identify many of them at present. The great naturalist, Pliny, with whose writings you will, no doubt, later become acquainted, who had more scientific knowledge than any of his predecessors, and repudiated many of the absurd talismanic influences then attributed to precious stones, could yet write such nonsense about the diamond as this:—"It is so hard, that if struck with a hammer upon an anvil, it will rather split both hammer and anvil than break itself, unless, indeed, it is first dipped in the blood of a goat, recently killed, in which case it will prove soft enough." In the days of Pliny, however, superstition was too rampant not to have veiled at times his keen and eager glance from the truth; but his enthusiasm was great, and his mind ardent for knowledge. He thus describes a precious stone as an object "in which the majestic might of nature presents itself to us, contracted within a very limited space, though, in the opinion of many, nowhere displayed in a more admirable form."

Similar thoughts conveyed in most eloquent language by our great art-critic, Ruskin, prevail in the following extract from "Modern Painters:"—"There are no natural objects out of which more can be learned than out of stones. They seem to have been created especially to reward a patient observer. Nearly all other objects in nature can be seen, to some extent, without patience, and are pleasant even in being half seen. Trees, clouds, and rivers are enjoyable even by the careless; but the stone under his foot has, for carelessness, nothing in it but stumbling; no pleasure is languidly to be had out of it, nor food, nor good of any kind—nothing but symbolism of the hard heart and the unfatherly gift. And yet, do but give it some reverence and watchfulness, *and there is bread of thought in it*, more than in any other lowly feature of all the landscape."

The Romans carried their love of jewelry to profusion. Among the treasures belonging to Theodosius are mentioned—

> " Sidonian mantles rich with purple fold,
> Belts bossed with pearls, robes stiff with gems,
> And breastplates shining green with emeralds bright,
> And helmets rich with precious sapphires dight."

Pliny says, "I have myself seen Lollia Paulina, once the wife of the Emperor Caligula, though it was on no great occasion, nor she in her full dress of ceremony, but at an ordinary wedding dinner—I have seen her entirely covered with emeralds and pearls, strung alternately, glittering all over her head, hair, bandeau, ears, neck, and fingers, the value of all which put together amounted to the sum of forty million sesterces" (£400,000).

Precious stones were considered the most acceptable offerings to the gods; thus Pompey consecrated to Jupiter the rarest mineral specimens found in the Pontic treasury; Cæsar, the possessor of the most valuable gems then known, dedicated six caskets to Venus; statues of divinities were profusely adorned with precious stones by their votaries. The goddess Astarte, according to Lucian, was adorned with diamonds, beryls, sardonyx, hyacinths, and emeralds, brought to hei shrine by Egyptians, Indians, Ethiopians, Medes, Armenians, and Babylonians, which shows the wide distribution of costly stones among the Eastern nations.

This religious dedication of precious stones had its votaries in the Middle Ages; the tombs of distinguished personages were adorned with gems, that of Edward the Confessor in Westminster Abbey had eighty jewels of great value; the shrine of Thomas à Becket, in the Chapel of the Holy Trinity in Canterbury Cathedral, was famous throughout the world for its riches. "The timber work of this shrine on the outside," says Stow, "was covered with plates of gold, damasked with gold wire, which ground of gold was again covered with jewels of gold, as rings, ten or twelve cramped with gold wire into the said ground of gold, many of these rings having stones in them, brooches, images, angels, precious stones, and great pearls." The contents of the shrine were in accordance with the outward display. Erasmus, who obtained a glimpse of the treasures a little before the Reformation says, that under a coffin of wood, enclosing another of gold, which was drawn up by ropes and pulleys, he beheld an amount of riches, the value of which he could not estimate. Gold was the meanest thing visible; the whole place glittered with the rarest and most precious gems, which were generally of extraordinary size, and some larger than the egg of a goose. This must have been exceedingly tempting to that lavish and profligate monarch Henry VIII., who accordingly seized upon the whole; and such was the enormous value of the wealth, that two great chests were filled, each requiring six or seven men to remove it. Another shrine, that of Bishop Hugh in Lincoln Cathedral, was of pure gold, and measured eight feet by four. This costly object was plundered at the dissolution of the monasteries, and the inventory of the jewels contained in it, with other treasures of the cathedral, fills several pages of the "Monasticon," Dugdale's great history of monastic establishments.

In the Middle Ages, the Abbey of St. Denis, in which the kings of France were buried, possessed a treasury that surpassed all others in the extraordinary amount of its precious stones, and other valuables, tributary offerings to the Virgin and the saints. It was considered one of the wonders of Europe, and attracted strangers from all parts. At the period of the French Revolution in 1793, a list of the treasures then remaining was made, and shows that if it possessed a great number of articles which credulity alone rendered valuable, it included others of which the intrinsic worth was immense.

I will merely mention a few objects in connection with the subject of this chapter:—A golden cross, two feet and a half long, richly studded with jewels, in which was enclosed a piece of wood, derived, it was pretended, from the true cross; two mitres of ancient abbots of St. Denis, variegated with precious stones; the head of St. Hilarius, covered with pearls and jewels; a cross of gold enriched with gems; vases of rock crystal and beryl; a golden eagle, enriched with a beautiful sapphire and other jewels; the head of St. Denis in gold, wearing a mitre covered with precious stones, and a shoulder-bone of the same saint, in a golden reliquary enriched with pearls and jewels; a piece of rock crystal, engraved, in a gold frame studded with pearls and precious stones; a lapis-lazuli set in gold and surrounded with pearls and jewels; a clasp of the mantle of St. Denis enriched with rings and precious stones; St. Louis's ring adorned with a sapphire; a crown of gold enriched with precious stones—among them was a ruby, in which was enchased a thorn, pretended to have belonged to the crown worn by Jesus Christ; the Abbot Suger's chalice, the cup of which was of a beautiful Oriental agate, exquisitely wrought; an agate upon which was represented a queen —the edge was of silver gilt, set with precious stones; a vellum manuscript, the binding ornamented with an immense number of precious stones; a clasp set with jewels; two pontifical rings, enriched with sapphires, encircled with pearls and precious stones; a crosier covered with gems, said to have belonged to St. Denis; a bust of St. Benedict, the mitre covered with small medals of agate and enriched with precious stones; a golden cross covered with pearls, sapphires, and emeralds; a reliquary of Charlemagne, adorned with jewels; an agate vase, covered with gems; a rare and beautiful vase of Oriental agate from Egypt; the crown of Charlemagne, of gold, enriched with jewels, used at the coronation of the kings of France; a clasp of gold, set with rubies and diamonds, and ornamented with a string of large Oriental pearls; the gold crown of the consort of Charles IV., set with gems; a book of the Epistles and Gospels, the gold binding covered with precious stones; a goblet made of an onyx adorned with gold and jewels; a shrine containing the bones of St. Louis, set with jewels; and another containing the body of St. Denis, enriched with gems, &c.

I must close this list of costly objects, which I have extracted—a few out of many—from the inventory to which I have alluded, in order to give you some idea of the estimation in which jewels were held formerly, and the manner of their application to the arts; the dedicatory offerings I have mentioned were considered the most valuable that could be given to propitiate the favour of Heaven—objects, however, that feebly represent—

> "The land where everlasting suns
> Shed everlasting brightness; where the soul
> Drinks from the living streams of love that roll
> By God's high throne!—myriads of glorious ones
> Bring their accepted offering."

Leaving this part of the subject, which is, however, of great historical and antiquarian interest—for the study of precious stones embraces a wide range of investigation,—I will mention a few of the principal gems in the mineral world, the diamond excepted, to which a special chapter has been already devoted as the jewel, *par excellence*, of the mineral world.

Among the rarest jewels is the ORIENTAL RUBY, belonging to the order of gems Corundum, which also includes Oriental sapphires, amethysts, topazes, and emeralds, which, as I have mentioned before, are crystallizations of the common substance that forms the basis of clays, pure alumina, coloured from admixture with oxide of iron. Now these crystallizations, I should tell you, have more in them than the striking brilliancy and ornament that please the eye of a mere casual observer. The thoughtful student gazes on them with far deeper and more hallowed feelings, for he sees the impress of the Divine Architect of the universe traced upon them in unmistakable characters: "their mathematical regularity," observes Mr. W. W. Smyth, "amidst seeming irregularity, revealing, under their numerous disguises, unerring laws, which link together groups of almost interminably varying forms." Thus Wordsworth, true philosopher of nature, says,—

> "Among these rocks and stones, methinks,
> More than the heedless impress that belongs
> To lonely nature's *casual* work : they bear
> A semblance strange, a Power intelligent
> And of design not wholly thrown away."

I should inform you that the term "Oriental," which is applied to certain precious stones, does not necessarily imply an Eastern origin, but is used in general terms to indicate perfection. I may also mention that the name ruby (from *ruber*, red) merely expresses a distinctive colour as being the red variety of the order to which the precious stone belongs.

The ruby, you will remember, was one of the jewels on the breastplate of Aaron, and was employed from the earliest times for the setting of rings. It is a stone of remarkable beauty and rarity ; indeed, it is stated by Mr. King (one of the best authorities on the subject) that a *perfect* ruby, exceeding one carat (which is in jewellery equal to three grains and two-fifths, troy weight), is still higher prized than the diamond. The gentleman whom I have named, mentions having seen one of three carats, for which three hundred pounds had been given. A diamond of the same weight, according to rule, would sell for no more than ninety pounds. A ruby of still finer quality, weighing only eleven grains, was recently purchased for eleven hundred pounds, or one hundred pounds per grain ; but rubies of much higher value are mentioned in connection with historic and other events : one, belonging to Rudolf II., was estimated in value at a sum amounting to thirty thousand pounds in our money, which falls far below its worth at the present time, for it was as large as a small hen's egg, and of perfect quality. The king of Ava is said to possess one of the same magnitude, which he wears as an eardrop.

The largest Oriental ruby known at present was brought from China, by Prince Gargarin, Governor of Siberia. It was afterwards possessed by Prince Menzikoff, and is now in the crown of the Emperor of Russia.

I have already mentioned the famous ruby (page 233) that formerly belonged to the Black Prince, and now adorns the imperial state crown of Queen Victoria.

Peter the Great, of Russia, that strange sovereign, when he left England, after having amused and mystified the people by his eccentricities, presented king William with a ruby, valued at ten thousand pounds, which he brought in his waistcoat pocket, and placed in William's hand, wrapped up in a piece of brown paper!

The old travellers revel in their description of the ruby, and I need scarcely remind you that considerable allowance must be made in many cases for exaggerations and fabulous stories. Marco Polo, the Venetian, an account of whose adventures appeared in 1298, mentions the "king" of Ceylon as having the largest ruby that was ever seen, being *a span in length*, and the thickness of a man's arm! "It has," he says, "the appearance of a glowing fire, and is so valuable that no estimate can be made of its worth in money. The Grand Khan Kublaï sent ambassadors to this monarch, with a request that he would yield to him possession of this gem, in return for which he should receive the value of a city. The answer given was to this effect, that he could not sell it for all the treasure of the universe, nor could he, on any terms, suffer it to go out of his dominions, as it had been handed down to him by his predecessors on the throne."

Sir John Mandeville, a traveller in the fourteenth century, and a sturdy believer in the marvellous, states, as an eye-witness, "that the Emperor (of Cathaye) hath in his chambre, in on of the pyleres of gold, a rubye and a charbuncle, of halfe a fote long, that in the nyghte semethe so grete clartee (brightness) and shynynge that it is as light as day!"

Similar stories of the great brilliancy of the ruby are related by the early Chinese travellers. One, describing Ceylon, states that in the seventh century a ruby was elevated on a spire, the light of which illuminated the skies. Another Chinese account mentions that early in the fourteenth century an officer was sent by the Emperor to purchase a carbuncle of unusual lustre. This served as the ball on the Emperor's cap, and at the grand levees held at night, the red lustre filled the palace, and was, for this reason, called the "Red Palace illuminator."

Tavernier, the French traveller, in the seventeenth century, says "that the throne of the Great Mogul was adorned with one hundred and eight rubies of from one hundred to two hundred carats each."

To account for the abundance of rubies found in Ceylon, it is stated in a Chinese work that the origin of trade in that island was coeval with the visit of the Indian god, Buddha, who sprinkled the land with sweet dew, which caused it to produce red gems, and thus gave the inhabitants wherewith to barter.

Among the many superstitions attached to the ruby in early times, I may mention that it was supposed to tell to the wearer, by the frequent change and darkening of its colour, that some inevitable misfortune was impending, and in proportion to the greatness of the evil, it was believed to assume a greater or less degree of darkness and opacity. "On December 5th, 1600," says Wolfgang Gabelehow, "as I was travelling from Stutgard to Calloa in company with my beloved wife, Catherine Adelmann, of pious memory, I observed, most distinctly, during the journey, that a very fine ruby, her gift, which I wore, set in a ring on my finger, had lost, once or twice, almost all its splendid colour, and had put on obscurity in the place of splendour, and darkness in the place of light; the which blackness and darkness lasted not for one or two days only, but several, so that being above measure alarmed, I took the ring off my finger, and locked it up in my trunk. Wherefore I repeatedly warned my wife that some grievous misfortune was impending over her or myself; nor was I deceived, for, in a few days, she was taken with a mortal sickness, that never left her until her death. After this its former brilliance returned again spontaneously to my ruby."

The ruby is mentioned by an ancient writer as a stone that gives the power of seeing in the dark, if hung around the neck. It also cured diseases of the eyes, if tied in a linen cloth over the forehead. Plutarch says, "It is discovered when the moon is waning to the sound of fifes, and is worn by people of exalted rank."

The Persian Hafiz sings of king Jamshid's celebrated ruby cup,—

"My wanderings brought me to the fast-closed niche
Where Jamshid's cup of sculptured ruby lay,
Blushed through the porphyry wall, its radiance rich,
As through the curtains peeps the rising day.

Earth, and earth's gifts were graven on its round,
Her cities, nations, of all tongues and kin,
The varied treasures in her bosom found,
And words of power the buried wealth to win."

After the diamond and Oriental ruby, the noble **Opal** is the most valuable of precious stones, some Oriental opals having been purchased at double the price that would have been given for sapphires of the same size. When you happen to be in the British Museum, you will see in the mineralogical department a fine specimen of the noble or precious opal, a most beautiful bluish-green mineral, which owes its fine play of colours to a multiplicity of imperceptible figures in its interior.

The Imperial Cabinet of Vienna possesses a magnificent opal, probably unique for size, but with several flaws, and irregularly polished. It is five inches long, and two and a half inches wide, and weighs seventeen ounces. The origin of this gem is unknown, but it has been at Vienna for two centuries.

The finest specimens of the noble or precious opal occur in Hungary, and some have been found in Saxony, South America, &c. The common opal has been discovered in Cornwall. Opal jasper has been found in Hungary and Siberia. India, or perhaps Arabia, supplied the best stones until a recent period. The opal is a compound of silica, one of the most primitive earths, the most abundant substance in nature and water. It is not of sufficient hardness to strike fire with steel. It is found massive, embedded in porphyry and trap rocks. The word *trap* is derived from the Swedish *trappa*, which signifies a stair, on account of the stair-like appearance which the vertical edges of these rocks exhibit when exposed to the weather.

The CAT'S-EYE, (so called from the changing pearly light it exhibits, which is not unlike that observed to emanate from the eye of a cat) is usually accounted a variety of the precious or noble opal. It is a transparent quartz, of a yellow hue, slightly tinged with green, and is full of minute fibres of "asbestos" (a term denoting its incombustible quality, for which it was used by the ancients for wrapping round dead bodies on the funeral pile, so as to prevent their ashes from mingling with those of the fire). The finest cat's-eyes in the world are obtained from Ceylon, and a perfect gem is still of considerable value in Europe. The Hindoos esteem it next to the diamond. It averages the size of a hazel nut, and is a favourite stone with jewellers. In 1820, one of these precious gems, about two inches broad, was sold for four hundred pounds. The largest now known is one inch and a half in diameter, and formerly belonged to the king of Kandy, now in the possession of Mr. Beresford Hope.

"Among the Marlborough gems, one of the most curious," says Mr. King, "is a singular conversion of a monster cat's-eye, an inch and a half high, into a lion's head, admirably carved out in full relief." De Boot describes the cat's-eye as good for all diseases of the eye, being placed under the lid, and allowed to work its way into the corner.

The finest opal of modern times was the Empress Josephine's, which was called the "Burning of Troy," on account of its appearance, which had the effect of flames of fire. The Turks esteem this precious stone as highly as the diamond. Pliny, describing this gem under the name Opalus, gives a highly wrought description of its qualities:—"Made up of the glories of the most precious gems, to describe it is a matter of inexpressible difficulty: there is in it the gentler fire of the ruby, there is the brilliant purple of the amethyst, there is the sea-green of the emerald, all shining together in an incredible union. Some aim at rivalling in lustre the brightest azure (Armenio) of the painter's palette, others the flame of burning sulphur, or of a fire quickened by oil."

The opal was an object of particular veneration to the ancients; Orpheus says,—

> "The opal fills the hearts of gods with joy,
> Whilst by the mild effulgence of its light,
> Its heating power restores the failing sight."
>
> KING.

Petrus Arlensis, a writer in the time of Henry IV., says, "The various colours in the opal tend greatly to the delectation of the sight; nay, more, they have the very greatest efficacy in cheering the heart and inward parts, and especially delight the beholder's eyes. One in particular came into my hands, in which such beauty, loveliness, and grace shone forth, that it could truly boast that it drew all gems to itself; whilst it surprised, astonished, and held captive, without escape or intermission, the hearts of all that beheld it. It was the size of a hazel nut, and grasped in the claws of a golden eagle, wrought with wonderful skill. It had such vivid and various colours, that all the beauty of the heavens might be viewed in it. It sent out such bright and piercing beams that it struck terror into all beholders." The writer of such a marvel as he has described must certainly have had a most elastic imagination.

Large opals are extremely rare; they are almost always found in very small nuts, and not being hard are easily scratched. The common opal has never more than one colour in the same stone; the milk-white variety, the girasole, when turned to the sun's rays, shows a yellow or red light; the green variety, as also the wax-yellow, sometimes called wax opal, are employed in jewellery.

"At present," says Barbot, a modern Parisian jeweller, "the opal has lost its ancient glory. Certain groundless stories, founded on the legend of Robert the Devil, have discouraged its use, and it is accused of bringing ill-luck to the wearer,—another proof that superstition is almost ineradicable in the human heart."

One of the most beautiful precious stones is the ORIENTAL SAPPHIRE, of a soft, velvety blue colour in its perfect state. It is highly transparent and brilliant, approaching closely in estimation to the diamond. As I before mentioned, it is a variety of corundum (a term applied to this order by the Indians), and is sometimes colourless; and these, called the *white*, are frequently sold for diamonds. The natives of Ceylon (in which island sapphires are chiefly found) had the art of bleaching this stone to such perfection, that they might have been taken for the finest diamonds. The sapphire more frequently exhibits exquisite colour, the red variety, as before stated, being the Oriental ruby; the blue is that commonly called sapphire. It is more rarely grey and green; the yellow and green sapphires are also much prized under the names of Oriental topaz and emeralds. Besides these shades of colours, sapphires often emit a beautiful display when held in different positions in the light. The name *girasole* sapphire is given to a fine variety with a pinkish or bluish tint, and a peculiar play of light. The *chatoyant* sapphire has a more pearly reflection; the *asteria* has in the midst of it a star of six bright rays, resulting from its crystalline structure.

Sapphires are also found in Pegu, in Bohemia, Saxony, and at Expailly in Auvergne, but the finest qualities come from the East. Fragments of blue sapphires, of an indifferent kind, are also found in India as large as the egg of a goose; the purple variety, or Oriental amethyst, is rare.

The largest sapphire known is in the Mineralogical Museum, at Paris. It is called the "wooden-spoon seller's," from the occupation of its finder in Bengal. The weight exceeds one hundred and thirty-two carats. It was bought by a French jeweller for 170,000 francs (£6,800).

The sapphire, you will remember, was one of the precious stones in the breastplate of the Jewish high priest. The ancients held this jewel in great estimation and dedicated it to Jupiter. It was supposed to be a great enemy to "black choler, and to free the mind and mend the manners;" when powdered and mixed with milk it was used for healing boils,—rather an expensive recipe, one would think, especially with merely a superstitious belief in its efficacy.

Another precious stone of which you have often read is the EMERALD, called by the Greeks *smaragdos;* but Mr. King, whose valuable works on gems have established his fame for learning and deep research, allows that the ancients, who judged principally by the eye, classed several different stones under this term, and he proves clearly that the true emerald was well known before the discovery of America; and the Romans, at least, he observes, were plentifully supplied with the true emerald. Emeralds are plentifully found both in antique and mediæval jewellery. Mineralogists generally regard this precious stone as merely another variety of the same species with the beryl, with which it essentially agrees in composition, crystallization, &c., differing in almost nothing but the colour, which is a velvety green. It consists of a combination of *glucina*, an earth thus named from the sweet taste of many of its saline forms; *silica*, one of the primitive earths; and *alumina*, or clay, with the colouring oxides of chrome and iron, and is found embedded in a vein of magnesian limestone, traversing hornblende rock. The finest specimens have long been brought from South America. The ancient inhabitants of Peru worshipped an emerald the size of an ostrich egg: it was exhibited at great festivals, and the Indians came in multitudes from all parts to see their goddess, and present emeralds to her. The priests and chiefs gave the people to understand that the goddess delighted in being presented with her daughters (the emeralds), and by this means the cunning fellows collected a great quantity of the precious jewels. The Spaniards, on the conquest of Peru, found all these "daughters of the goddess," and took them without ceremony; but the Indians so effectually secreted the "mother," that she has not yet been found. Emeralds were employed, in preference to all other gems, by the Peruvians, for adorning jewelled goblets.

I have already mentioned the famous emerald mines of Mount Zebarah in Egypt (page 146), from whence the ancients derived large quantities of the precious jewel. An inferior quality is found in Europe, embedded in mica-slate in the Henbach Valley in Salzburgh. They are also obtained in the Ural Mountains.

Several remarkable stories are told by the ancients of the emerald. Nero, the tyrant, who was extremely short-sighted, is said to have used one as an eye-glass, for viewing the sanguinary combats of the gladiators at Rome, but this statement is open to doubt; though an anecdote is related of Maximilian II., who wore a ring with an emerald stone. On his visit to Ratisbon, the citizens presented him with a gold cup, full of money. Whilst the courtiers were engrossed in looking out of the window, at a grand show given in the streets in honour of the occasion, the Emperor detected, by the reflection in the stone of the ring upon his finger, one of their number taking occasion to slip unobserved to the cup, still standing on the table of the reception-room, and help himself to a handful of its contents.

Beckman says, "It may be objected that real emeralds are too small to admit of being used as mirrors, but the ancients speak of some sufficiently large for that purpose, and also of artificial ones, so that we may with certainty conclude that they classed among the emeralds fluor-spar, green vitrified lava, green jasper, and green glass."

The emerald was supposed to "pacify all affections of the mind" of the wearer, and ring-stones made of it were worn as good for the eyes. Pliny states that gem-engravers were accustomed to refresh their wearied sight by gazing for some minutes upon an emerald kept at hand for that purpose. It was also considered a specific against epilepsy, and a cure for dysentery.

So greatly was it valued by the Romans, Pliny states, that when the famous Lucullus landed at Alexandria, Ptolemy, wholly engrossed with the desire of attaching him to his interest, could find him nothing more precious than an emerald set in gold, and on which his portrait was engraved.

As a precious stone the emerald is rarely without flaws ; the value also depends much upon its colour. A very perfect specimen of six carats has been sold for a thousand pounds. The largest emerald known is that called the "Devonshire," two inches in diameter, of the finest colour, and perfect, not cut. "A singular property in the emerald," says Mr. King, "not observed in any other coloured stone, is, that if a large flat one is held so as to reflect the light, it will assume the exact appearance of being silvered on the back ; its green disappears when its plane is brought to a certain angle with the ray of light, and it will seem exactly like a fragment of looking-glass in the same position." The Hindoos of every age have greatly admired the emerald, especially when formed into a pear-drop, pierced at the small end, and worn as a pendant in the ear.

There are clever imitations of emeralds. Mr. King informs us that the natives of Ceylon eagerly seek for the thick bottoms of our wine-bottles, out of which they cut the "precious stone" for sale to the "steamboat gentlemens" at high prices. The Brighton emeralds are said to be produced in a somewhat similar manner. The lapidaries throw fragments of glass into the sea, and recover them altered to the form of real pebbles by the attrition of the shingle.

The AMETHYST owes its name to a Greek word signifying *unintoxicated*, from a belief among the ancients that this precious stone had the virtue of preventing any evil arising from excess in drinking. It was obtained by them from India, Arabia Petræa, Armenia Minor, Egypt, and Galatia. The finest specimens are still derived from the East. It is, however, a common mineral in Europe, and occurs in many parts of Scotland, frequently lining the interior of balls of agate, and in veins and cavities of greenstone and other rocks.

The common amethyst is nothing more than rock-crystal, coloured purple by manganese and iron. It was highly esteemed in the last century, and again became a popular stone a few years ago. So capricious are the changes of fashion, that queen Charlotte's splendid necklace of amethysts, formerly worth two thousand pounds, would not now sell for as many shillings, the jewel market being overstocked with Hungarian and Bohemian amethysts. As Burns sings,—

"Mark yonder pomp of costly fashion,
Round the wealthy bride;
But when compared with real passion
Poor is all that pride,—
What are their showy treasures?
What are their noisy pleasures?
The gay, gaudy glare of vanity and art:
The polished jewel's blaze
May draw the wondering gaze,
But never, never can come near the worthy heart."

A crystal of the sort I have mentioned has been found weighing one hundred and forty pounds, a bulk which almost puts it out of the reach of precious stones. It is therefore of an entirely distinct species from the true Oriental amethyst, a scarce and valuable variety of the precious corundum, the purple sapphire, as I have before stated.

Like most of the other precious stones, it was an object of superstition among the ancients. Pliny says, "that if the name of the moon or sun be engraved upon it, and the amethyst be hung about the neck from the hair of a baboon, or the feather of a swallow, it is a charm against witchcraft; the jewel keeps off hailstones and flights of locusts, with the assistance of a spell." Pliny, however, while recapitulating these extravagances, had a quiet laugh at many of them as the fabrication of the "lying Greeks."

In our own days the Roman Catholic bishops wear a ring of amethyst, whence it has received abroad the name of "bishop's-stone."

In Ceylon the largest amethysts are cut for buttons; the more saturated the colour is in them, the more they are esteemed. They seldom reach the size of a walnut, and those of a paler colour are less valued. In the Brazils, specimens are met with of two colours, generally violet and yellow, or violet and green.

The amethyst was the eighth of the twelve stones in the breastplate of Aaron.

The BERYL is a mineral which scarcely differs in colour from the emerald, never displaying the bright rich green which characterizes that gem, but colourless, yellowish, greenish yellow, or blue. The fluor varieties, which are transparent and of beautiful colour, are distinguished as precious beryl, and are sometimes called aquamarina. The beryl was anciently held to be of equal worth with the emerald, but the vast supplies of modern times have rendered it, although a beautiful and lustrous stone, comparatively valueless. In the British Museum are two specimens from New Hampshire, weighing respectively twenty-eight pounds and eighty-three pounds. The finer beryl occurs chiefly in veins that traverse granite or gneiss, or embedded in granite; sometimes it is taken in alluvial soils formed from such rocks. The common description is found in several parts of Europe; Aberdeenshire is a British locality. The mountains of Aberdeenshire and those of Moarne, in Ireland, produce also the precious beryl, which is found likewise in America, but chiefly in Brazil and Siberia.

The virtues of the beryl were much extolled by the old writers:—"It much avails to a good understanding, represseth vain conceits and evil thoughts; it also causeth mirth." The beryl was a great favourite with the necromancers; the conjurer, having repeated the necessary charms and adjurations, looked into the stone to see the answer, represented by types and figures.

Lilly, the astrologer, describes one of these beryls as large as an orange, set in silver, with a cross at the top, with the names of the angels Raphael, Gabriel, and Uriel engraved upon it.

Few gems were invested with more wonderful properties than the TURQUOIS, some of which I have mentioned. Besides strengthening the eyes and cheering the soul of the wearer, it took upon itself the consequences of any fall that might happen to him by cracking itself, and thus saving him the fracture of a bone. It was supposed to grow paler as the wearer sickened, and lost its colour entirely upon his death, but recovered it when placed on the finger of a new and healthy possessor. Suspended by a string within a glass, it told the hour by the exact number of strokes it gave.

The change of colour in the turquois is alluded to, among others, by Ben Jonson:—

> "Observe him as his watch observes his clock,
> And true as turquois in the dear lord's ring
> Look well or ill with him."

Donne, also, says,—

> "As a compassionate turquois that doth tell,
> By looking pale, the wearer is not well."

It is a mineral hitherto found only in Persia, and consists of phosphate of alumina, or clay, containing also a little of the oxides of iron and copper. The colour is a greenish blue. It is sometimes called Oriental turquois, whilst the name Occidental turquois is given to a substance of similar colour found in Languedoc, but which is said to be merely bone, coloured with phosphate of iron. Brand mentions a set of twelve turquoises about the size of a nail, all alike in size, form, and colour, on which were engraved the heads of the twelve Cæsars, valued at nearly four hundred pounds.

AGATES are composed of layers of quartz, generally of different varieties, intimately joined together, and are found of all colours, sometimes exceedingly vivid. In modern mineralogy this stone is an impure variety of chalcedony, which derives its name from Chalcedon, that once famous city of Bithynia, in Asia Minor. The rocks near this place, which is not far from the present Scutari, contain this stone in considerable quantities. Chalcedony consists of silica and alumina, and comprises besides agate, heliotrope, onyx, plasma, and sard, differently coloured by metallic oxides. It is found in grape-like masses, but more frequently in rolled pebbles. The finest Oriental chalcedony presents in its interior a fine mottled appearance.

The first engraved gem that Pliny mentions is an agate that belonged to Pyrrhus, king of Epirus. This was in the first half of the third century before Christ. The same monarch is said to have had in his possession an agate on which were figured the nine Muses, and Apollo holding a lyre; the work not of an engraver, but of Nature herself! The veins in the stone were said to be arranged so naturally, that each of the Muses had her particular attribute. This somewhat tries our powers ot belief, but the freaks of nature are sometimes very strange.

If you should happen to be in the mineralogical department of the British Museum, you will see a curious specimen of the Egyptian jasper, in which may be seen a tolerably distinct likeness of the poet Chaucer, formed by the natural veining of the stone; and flints have been found, when broken, to exhibit likenesses of well-known personages,—such, for instance, as the late Duke of Wellington, the portrait being usually formed by the arrangement of the white veins or lines in the black substance of flint.

At a late period, and even in the Middle Ages, it was a popular belief that the engraved gems found in digging the ground of ancient sites were natural objects, and that the representations on them were a mere natural indication of the special power or quality each possessed.

Busts and heads in full and bas-relief were executed by the Romans on chalcedony in the grandest style; the finest specimens of these that we possess are the Marlborough "Medusa," and the bust of "Matidia," supported on a peacock, and three inches high. The chalcedony was supposed to cure lunatics, and make them "amiable and merry."

The agate was an object of the most fanciful delusions to the ancients; Orpheus says, "If thou wearest a piece of the tree agate on thy hand, the immortal gods shall be pleased with thee; if the same be tied to the horns of thy oxen when ploughing, or round the ploughman's sturdy arm, wheat-crowned Ceres shall descend from heaven with full lap upon thy furrows." He adds, that every kind is an antidote to the asp's bite, if taken in wine; but the more potent brocatella, if merely tied on the wound, cures the scorpion's bite, attracts love, obtains every petition from the powerful, and cures the sick.

By burning the agate it was believed that storms would be averted, and thunderbolts to boot; the proof of their efficacy being that if thrown into a cauldron oi boiling water, they immediately cooled it; but in order to do good, they must be strung on the hair of a lion's mane. The stone, coloured like a hyena's skin, was believed as the cause of domestic strife, and was viewed with horror.

How firm was the faith of our forefathers in the medical virtues of the agate is curiously exemplified by a jewel presented to Queen Elizabeth by Archbishop Parker. It is a large oval agate, engraved with a fine intaglio representing Venus in Vulcan's forge, and set for a pendant. The parchment accompanying the gift contains a long account of the numerous virtues of the gem. I may here remark that Elizabeth had a right royal partiality for precious stones, with which she profusely adorned her person on state occasions, and employed them otherwise as well, as the description of her carriage by a contemporary writer shows:—

> "He happy was that could but see her coach,
> The sides whereof, beset with emeralds
> And diamonds, with sparkling rubies red."

"When camei," observes Mr. King, "first came into fashion for ornaments in England, they went by the name of agate-stones." Thus Shakspere has the simile,—

> "If low, an agate very vilely cut."

Queen Mab is described—

> "In shape no bigger than an agate-stone
> On the forefinger of an alderman."

The Topaz occupies some distinction among gems. The finest varieties are found in the Brazils, Ceylon, and the Ural mountains, either crystallized, or in small rolled masses in the alluvium of granitic rocks, about the size of a large nut. In colour they are commonly white, bluish, or yellowish white, much waterworn, and perfect crystals of it are rare. The common kinds are found in many parts of the world. A crystal, nineteen ounces in weight, was discovered in the Cairngorm mountains, in Aberdeenshire, and some have been obtained in Cornwall and Ireland. It is rendered very electric by heat and friction; and by this property a topaz may be readily distinguished from a diamond or ruby, for which otherwise, when cut and set, it might easily be mistaken.

The topaz of the ancients had a green colour, and is supposed to have been our chrysolite. It was found in the island of Topazios (hence the name), in the Red Sea. "This place," says Diodorus Siculus, "was ten miles long, and called the Island of Serpents, from the number of reptiles formerly infesting it. The topazion here found was a transparent gem, agreeable in aspect, resembling glass. No one was allowed to land there under pain of death, and no boat was allowed to be kept on the island. Provisions for the few soldiers on guard there were brought at intervals from the continent. The gem was not discernible by day, its lustre being then overpowered by the sun's rays, but at night it was conspicuous by its brightness .The guards who divided the island among their patrols then ran up, and covered the luminous spot with a vase of equal size. Next day they go their rounds, and cut out the patch of rock thus indicated, and deliver it to the proper person to be polished."

The chrysolite, which this is said to represent, was considered of great virtue in scaring away evil spirits, "if strung on a hair out of an ape's tail."

JASPER is a very common mineral, one of the varieties of quartz, found in veins and embedded masses in many rocks, sometimes appearing as a rock on which whole hills are formed, and very common as pebbles. These stones are of all colours, red, brown, green, yellow, &c.; that called the Egyptian being much prized on account of its beauty, and the brilliant polish that can be given to it. The locality of this variety is Egypt, whence it is named, and it is there found in the sands, as also in those of the neighbouring deserts. Porcelain jasper, which is, in fact, a species of natural porcelain, is produced by the spontaneous combustion of slaty clay in the vicinity of coal-beds on fire. The jasper was considered a talisman by the Roman wrestlers, to renew their strength and render them invincible.

Of all the precious stones that have the widest geographical range, I must mention the GARNET, which has been found in Ross's Islet, one of the most northern known lands in the globe. You have, no doubt, frequently seen this beautiful and useful stone, as, although of comparative little value in consequence of its abundance, it is extensively used by jewellers for ornaments. There are numerous varieties of this stone, differing considerably in chemical composition, and of various colours. The noble or precious garnet is generally crimson red, and is found in the mountainous parts of England and Scotland, but the finest qualities are obtained from Ceylon and Pegu, red garnets sometimes containing so much oxide of iron, the colouring mixture, that they are attracted by the magnet.

The CARNELIAN, the modern name for the sardius, is supposed to have been thus designated from its colour of red flesh (*carneus*). Sardius was derived from the Persians; the Babylonian mines produced the sort first known and most esteemed, and these held the first place in the list of stones employed by the first engravers. The sard was esteemed of wonderful virtue; it was supposed to cure tumours, and all wounds produced by iron—to drive away evil spirits, and to stop bleeding. Albertus Magnus affirms that this stone "exhilarates the soul, drives away fear, destroys witchcraft, and is an antidote to poison." Cardan says that "it gives success to lawsuits, and makes the wearer rich."

LAPIS-LAZULI, or azure-stone, furnishes the valuable paint called ultramarine, an inalterable colour. The mineral consists of silica, alumina, and lime, with an admixture of soda, oxide of iron, magnesia, and sulphuric acid. It has a hardness sufficient to scratch glass, and is usually found massive in Siberia, China, Tibet, Chili, &c., but the finest specimens are brought from Bucharia. Before the true precious stones were introduced from India this mineral held the highest place in the estimation of the primitive nations of Asia and Greece; in fact, Mr. King tells us it was almost the only stone known to them having beauty of colour to recommend it. This was the only stone, of any intrinsic value, known to the Egyptians under the Pharaohs, hence it abundantly occurs in their jewellery that has come down to us, worked up with signet-stones, pendants, and charms.

It is extensively employed in ornamental and mosaic work, and for sumptuous altars and shrines.

THE FABRICATION OF GEMS has been a productive art from the earliest times; what are called "pastes" are imitations of the precious stones, and also of engraved gems. The ancients trafficked largely in these practices. The Egyptian glass-workers produced mosaics, beautifully finished, and sufficiently small to be inserted in rings. Pliny, in his description of precious stones, frequently alludes to the difficulty of detecting these counterfeits. A jocular punishment was inflicted by the Emperor Gallienus upon a jeweller who had thus deceived his wife, Salonina. The poor wretch was sentenced to be thrown into the arena, to be devoured by wild beasts. He was stripped naked and left in trembling expectation of his fate ; the door of the den was raised, when out strutted a cock, and the culprit got off with the fright alone, Gallienus declaring "it was but fair that one who had deceived others should himself be made a fool of."

The art of imitating precious stones was taken up in modern times by the Regent Orleans, of France, under whose patronage it rapidly attained to perfection and celebrity, far exceeding the arts of the ancients. The new process gradually diffused itself throughout Europe, and when Goethe visited Rome, he found the making of pastes a favourite occupation. Paris is now the centre of this art. Wedgwood's seals and camei close the series of modern pastes, but the material is different, being porcelain instead of glass.

An Eastern origin is ascribed to the engraving on gems. Less than a century before Christ, Mithridates, the celebrated king of Pontus, possessed a museum of signet rings. As a general rule the ancients did not engrave such precious stones as the diamond, ruby, and sapphire, being content with those of less hardness and value. Those incised are called "intaglios," those which are raised, "cameos :" the Greek works of both these classes are pre-eminently beautiful. In the fifteenth century, this art, which before then had been almost lost, was revived with great success. In the following century shells were first used for cameos, which up to that time had always been of precious stones. During the seventeenth century the art declined, but at the close of the eighteenth, Joseph Pichler produced beautiful examples of gem engraving, of so fine a character that many might be mistaken for antiques. The well-known gems collected by Prince Poniatowski, which for some time were considered ancient, were executed chiefly by Roman artists in the present century.

Besides glass, impressions of gems are now taken in sulphur, gutta-percha, and plaster of Paris.

The large camei of the European collections, however, appear to have been brought by the Crusaders from the East. The French collection dates from Charles the Ninth, and is very rich in gems of all kinds; that of Berlin consists of nearly five thousand stones. The Vienna collection, far less numerous, has, however, some large camei. The collection in the British Museum contains about five hundred stones of great beauty and merit, but poor in camei. The Duke of Devonshire possesses upwards of five hundred intagli and camei, including some of the finest known. The Marlborough, still more numerous, comprises many beautiful stones. The Pulzky collection, now in Italy, contains many rare and choice intagli.

There are probably about ten thousand gems reputed to be antique.

I must now bring this long chapter to a close. My design has been to make you acquainted with some of the principal precious stones only, the beauty and rarity of which might alone entitle them to rank among the "TREASURES OF THE EARTH," not as ornaments only, for some of them are of considerable use in connection with the arts, especially in preserving to us, as I have related, the masterpieces of the ancient engravers, which have spread such a light upon the history and habits of people in bygone ages.

I have not adopted any mineralogical order in my notices, not pretending to be a teacher in that science; but I shall be glad if the information I have given, scanty as it is, will lead you to look for far deeper knowledge from the great mineralogists of the past and present time, who have devoted the whole energies of their minds to the elucidation of the "mysteries of nature," and learn, as Cowper beautifully expresses this truth:—

> "Thus studied, used, and consecrated thus,
> On earth what is, seems formed indeed for us:
> Not as the plaything of a froward child,
> Fretful, unless diverted and beguiled;
> But as a scale by which the soul ascends
> From mighty means to more important ends;
> Securely, though by steps but rarely trod,
> Mounts from inferior beings up to God;
> And sees, by no fallacious light or dim,
> Earth made for man, and man himself for Him."

CHAPTER XVII.

CROWNS.

"A *crown*,
Golden in show, is but a wreath of thorns ;
Brings dangers, troubles, cares, and sleepless nights
To him who wears the regal diadem,
When on his shoulders each man's burden lies.
In therein stands the office of a king ;
His honour, virtue, merit, and chief praise,
That for the public all this weight he bears."

MILTON.

IN connection with the preceding chapter on precious stones I may appropriately introduce a few remarks upon CROWNS, the decorations of which, particularly at a later period, included the most rare minerals that were known in those times. I may consider this chapter of more interest than importance, yet at the same time it is well you should understand that these ensigns of royalty have a far deeper value than the mere intrinsic quality of their materials can convey. The "cross," and the "lilies of the field," are types—the one of the Redeemer, "who purchased us unto Himself;" and the others the beauty of humility, which "not even Solomon, in all his glory," could rival, but which was so transcendently exemplified by the gentle Saviour himself. The badges of royalty are but the similitude of things heavenly, to which all that is human must bow, to the KING OF KINGS and the LORD OF LORDS.

You will find that crowns are frequently mentioned in

Scripture. The royal crown originated in the diadem, which was a simple fillet bound round the head and tied behind. This practice, however, with people who wore long hair was common, so kings were distinguished by a fillet of a different colour than that usually worn; and being thus established as a regal distinction, it continued to be used as such even among nations who did not wear the hair long, or was employed to confine the head-dress. The crown, however, as distinguished from the diadem and the emblem of sovereignty, was, according to the Rabbins, of gold set with jewels; such was the crown that David took from the king of the Amorites, and afterwards wore himself, as did probably his successor. Of its shape it is impossible to form any notion. In Egypt and Persia there are sculptures representing crowns in the shape of a distinguishing tiara, cap, or helmet of metal or cloth. "Crowns," observes Dr. Kitto, "were so often used symbolically (in Scripture) to express honour and power, that it is not always safe to infer national usages from the passages in which they occur."

Among the Persians the diadem was bound round the turban, and was of a blue colour worked with white. The early Roman emperors refrained from using the diadem, in order not to recall recollections of the hateful kingly office. Diocletian was the first to introduce it again, and Constantine the Great added new ornaments to it. After his time it was adorned with a single or double row of pearls and precious stones.

In modern states, crowns were of various forms until heralds devised a regular series of them, to mark the various gradations of sovereignty, from that of the Emperor down to what is called coronets of counts and barons. The crowns of emperors and kings are closed above, whilst the coronet of a noble is merely an open circlet surrounding the head.

In the Cluny Museum at Paris—which contains a most valuable collection of antiquities—are some ancient Gothic crowns, which were discovered in a singular manner by a few labourers in the course of excavating a cemetery near Toledo, in Spain. No remains of a case in which these relics had been enclosed were found, so it is supposed that these precious objects had been buried in some time of confusion without any case. The treasure consisted of eight crowns; four are of gold richly jewelled; from the front of the crowns, jewelled crosses are suspended by gold chains; there were also chains of the same metal for hanging the crowns. These were brought to Paris by the proprietor of the ground in which they were found, and sold to the French Government. The largest of the crowns bears the following inscription in letters jewelled and appended by little chains:—"Reccesvinthus rex offeret" (offered by Reccesvinthus the king). The letters are about two inches in length each, and are separately hung, each bearing a pendent pearl and sapphire. The gold letters are beautifully encrusted with precious stones, and engraved in the same manner as some of the gold-work of the Anglo-Saxon period. The monarch thus mentioned governed Spain from 653 to 675; the inscription also shows that it had been some offering to a shrine, as were most probably the seven other smaller crowns, from an inscription to that effect on one of them.

The crown of the king measures about nine inches in diameter, and twenty-seven in circumference, and the entire length, from the gold hook to which it is fastened, to the lowest pendent sapphire attached to the cross, is about three feet. The whole of the crowns are in excellent preservation, and are highly enriched with gems, forming one of the most interesting discoveries of the kind in modern times.

You will probably be glad to know something about the crowns of our own country. I have already (in page 232) mentioned the state crown of England, as described by Professor Tennant, in connection with the large amount of diamonds which compose its decoration. A fillet diadem of pearls seems to have been the badge of royalty with the Saxon monarchs; the circle surmounted by three small projections first occurs upon the coins of Athelstan. In the inventory, made by order of the Parliament, of the regalia or jewels of the Crown found in Westminster Abbey, in 1649, the only crown besides that of the Queen's is called "King Alfred's crowne," which is described as being made of gold wirework, set with slight stones, and having two little bells. A radiated cap appears first on a coin of Ethelred II., and the trefoil ornament upon the crown of Canute. Harold is represented with a square crown. Upon some of the coins of our earliest Anglo-Norman monarchs, William I. and William II. wear something like an arched crown, flat-topped and square. The crown upon the great seal of Henry I. is open and round, surmounted by three pinnacles, and having appendages on each side to fasten the crown under the chin, as we learn from an anecdote, related by William of Malmesbury, the historian, that Archbishop Ralph snatched the crown rudely from the head of the monarch, and broke the clasp. The crown carried before Richard I. is stated to have been set with rich jewels. King John had several crowns, and found them worse than troublesome; he realized, to its fullest extent, the weight of care that Shakspere describes :—

> "O polished perturbation ! golden care,
> That keeps the ports [gates] of slumber wide
> So many a watchful night : he sleeps with 't now,
> Yet not so sound and half so sweet
> As he, whose brow with homely biggin [cap] bound,
> Snores out the watch of night. O majesty,
> When thou dost prick thy bearer thou dost sit
> Like a rich armour worn in heat of day,
> That scalds with safety."

King John lost his crowns, and other costly effects belonging to the regalia, in the waters of the Welland, while he was crossing the Wash, near Wisbeach, in 1216. Henry III. had three golden crowns, which he turned to some use by pledging them to French merchants in his necessities; and this example was followed by several of his successors when they needed money, which was no rare case. Edward I., according to Camden, made no bad jest, "that whereas the kings of England before his time used to wear their crowns on all solemn feast-days, he first omitted that custom, saying merrily that 'crowns do rather onerate than honour princes.'" This we can easily understand when we are told that the crown of Richard I. was so heavy that two earls supported it, after it was placed on his head. The crown of Alfred the Great, to which I have alluded, weighed upwards of six pounds and a half.

The crown of Edward II. was surmounted with oak leaves. A crown called the "Harry" was broken up by order of Henry V., and distributed by way of pledge amongst several persons. The victor at Agincourt was meditating fresh conquests over his French foes. These jewels were afterwards redeemed by his son, Henry VI., but only to make a similar use of them shortly afterwards. The crown of Edward VI. was discovered in an iron chest in 1649. It was enriched with one fine diamond, valued at two hundred pounds, thirteen other diamonds, ten rubies, one emerald, one sapphire, and seventy pearls. Queen Mary, like Edward VI., had three crowns; her sister Elizabeth, two. In a list of the crown jewels made in the reign of James I. there is a most complete account of the imperial crown of England as it existed in the second year of that monarch's reign. It is described as set about the nether border with nineteen great pointed diamonds, and between each a knot of pearls, set by five pearls in a knot; in the upper border eight rock rubies, and twenty round pearls, the four arches being set, each of them, with a table diamond, a table ruby, an emerald; and upon two of the arches eighteen pearls, and upon the other two arches seventeen pearls; and between every arch a great *ballace* (pink ruby), set in a collet of gold, and upon the top a very great ballace, pierced, and a little cross of gold upon the top, enamelled blue.

There were also a coronet of gold, set about the nether border with four blue sapphires, four ballaces, one emerald, five roses of diamonds, and fourteen round pearls; and about the upper border, set with three blue sapphires, three ballaces, and six pearls, having in the middle a small pointed diamond.

As mention is made of "one circlet, new, made for the Queen," it is supposed that the above crown and coronets were the relics of past days, and had been worn by the kings and queens immediately preceding James.

The state crown of Charles I., found in the Upper Jewel-house in the Tower, was enriched with twenty-eight diamonds, three hundred and eighty sapphires and rubies, two emeralds, two hundred and thirty-two pearls, twenty-one rubies, and the weight of gold was seven pounds seven ounces.

What is called St. Edward's crown was made for the coronation of Charles II., but was thus named from having been formed after an ancient crown which is said to have been worn by king Edward the Confessor, and was broken up and sold during the civil wars. It is formed of four crosses, and as many fleurs-de-lys of gold. From the four crosses rise four circular bars, which meet at the top in the form of a cross; at the intersection is an orb of gold, enriched with precious stones surmounted by a cross of gold and gems, with three very large oval pearls, all of them fixed at the top. The whole is ornamented with diamonds, emeralds, rubies, and sapphires.

It was during the reign of Charles II. (May 9th, 1671) that the daring attempt of Blood to steal the crown from the Tower was made. The story is well known, but in connection with my subject will bear repeating, especially as the truth of this singular occurrence is undoubted. The details are given in Strype's edition of Stow's "Survey of London," and in other works. Strype mentions that he had the account from Edwards, the keeper of the regalia in the Tower at the time (or more probably his son).

Thomas Blood was a native of Ireland, and served as a lieutenant in the parliamentary forces. He was a man of the most desperate character, and one of the ring-leaders, at the restoration of Charles II., in an attempt to surprise Dublin Castle, and seize the Duke of Ormond, the Lord Lieutenant. This plot was, however, unsuccessful, and Blood escaped; but some years afterwards, being determined to revenge himself upon the same nobleman, who was then in England, he waylaid him on the night of December 6th, 1676, tied him on horseback to one of his associates, and but for the timely assistance of one of the duke's servants, would have carried out his intention of hanging him at Tyburn. Owing to the means taken by Blood to disguise himself, he was not suspected of this offence, although a reward of a thousand pounds was offered for the apprehension of the perpetrators.

Such was the man, who, with a few companions as reckless as himself, made the daring attempt upon the regalia in the Tower. About three weeks before this occurrence, Blood went to the Tower disguised as a parson, accompanied by a woman whom he called his wife—his real wife being then in Lancashire. The lady requested to see the crown, and her wish being gratified, she feigned illness, and Mrs. Edwards, wife of the keeper of the crown jewels, after giving her some spirits at her husband's request, invited her to repose herself upon a a bed. She soon recovered, and after many thanks, left.

In a few days Blood returned, and gave Mrs. Edwards four pairs of white gloves, as a present from his pretended wife, and told her that "she had long studied, and, at last, bethought her, of a handsome way of requital." This was no other than a match between a nephew of his and the Keeper's daughter. Blood had so well contrived his plans, that a day was appointed for the young couple to meet. He was invited by old Edwards and his wife to dine with them, which was willingly accepted, Blood "taking upon him to say grace," and performing it with great seeming devotion, concluding his oration with a prayer for the king, queen, and royal family.

After dinner "he went up to see the rooms, and seeing a handsome case of pistols hanging there, expressed a great desire to buy them, to present to a young lord who was his neighbour," but this was merely a pretence by which "he thought to disarm the house," and thus execute his design with less danger. At his departure, "which was with a canonical benediction to the good company," he appointed a day and hour for introducing his young nephew to his future bride, and as he wished, he said, "to bring two young friends with him to see the regalia, who were to leave town early on that morning," the hour was fixed at about seven o'clock. On the appointed morning, "the old man (Edwards) had got up ready to receive his guests, and the daughter had put herself into her best dress to entertain her lover, when behold, parson Blood, with three more, came to the Jewel-house, all armed with rapier-blades in their canes, and every one a dagger and a pair of pocket pistols. Two of his companions entered in with him, and a third stayed behind, for a watch."

Blood told Mr. Edwards that they would not go up-stairs until his wife came, and desired him to show his friends the crown to pass the time till then. This was complied with; but no sooner had they entered the room where the crown was kept, and the door, as usual, been shut, than "they threw a cloak over the old man's head, and clapt a gag into his mouth, which was a great plug of wood, with a small hole in the middle to take breath at; this was tied with a wax leather, which went round his neck. At the same time they fastened an iron hook to his nose, that no sound might pass from him that way either."

Thus secured, they told him "that their resolution was to have the crown, globe (orb), and sceptre; and if he quietly submitted to it, they would spare his life, otherwise he was to expect no mercy." Notwithstanding this threat, "he forced himself to make all the noise that he possibly could to be heard above;" they then "knocked him down with a wooden mallet, and told him that if yet he would lie quiet, they would spare his life, but if not, at his next attempt to discover them, they would kill him, and pointed three daggers at him." Edwards, however, by his own account, was not yet intimidated, but "strained himself to make the greater noise." In consequence, they gave him "nine or ten strokes more upon the head, with the mallet, and stabbed him in the stomach." This ferocious treatment occasioned the old man, then almost in his eightieth year, to swoon, and he lay sometime in so senseless a condition, that one of the miscreants said, "he is dead, I'll warrant him." Edwards, who had come a little to himself, heard these words, and thought it best to lie quietly.

The rich prize was now in the hands of the villains; one of them, named Parrot, "put the globe (orb) into his breeches; Blood held the crown under his cloak, and the third was proceeding to file the sceptre in two, in order that he might put it into a bag," because it was too long to carry, when one of those singular events occurred, that sometimes happen to prevent the commission of crime, when at the point of seeming success. This was the sudden arrival of a son of Mr. Edwards from Flanders, who, having first spoken to the person who stood on the watch at the door, went up stairs to salute his relations. Seizing this opportunity, the ruffians instantly "hasted away" with the crown and orb, leaving the sceptre unfiled.

The old keeper now raised himself, and freeing his mouth from the gag, cried, "*Treason! Murder!*" which being heard by his daughter, she rushed out of doors, repeating the cry, with the addition, "*the Crown is stolen!*" The alarm being thus given, young Edwards and Captain Beckman, his brother-in-law, pursued the robbers, who were advanced beyond the main-guard (at the White Tower), and were hastening towards the drawbridge. Here the warder "put himself in posture to stop them," but, on Blood firing a pistol at him, he fell, although unhurt, and the thieves "got safe to the little Ward-house Gate, where one Sill, who had been a soldier under Cromwell, stood sentinel," but he, offering no opposition, "they passed over the drawbridge, and through the outward gate upon the wharf." Horses had been stationed for them at St. Katherine's Gate, and as they ran that way, they raised the cry of "*Stop the rogues!*" by which device they proceeded unopposed, until overtaken by Captain Beckman, at whose head Blood discharged his second pistol; but the captain avoided the shot by stooping down, and immediately seized the ruffian. The crown was still beneath his cloak, and, although every chance of escape was now over, he struggled vigorously to retain his prize, and when it was wrested from him, exclaimed, "*It was a gallant attempt, however unsuccessful, for it was for a crown!*"

In the struggle a large pearl, a diamond, and a number of smaller stones, were loosened from the crown, but both the former, and several of the latter, were picked up and restored; the pink ruby which had been broken off the sceptre, was found in Parrott's pocket, so that nothing of considerable value was lost. The latter was stopped by a servant, and Hunt (Blood's son-in-law), who had been waiting with the horses, was soon afterwards seized, together with two others of the party.

The outrage was soon made known to King Charles, who commanded that the two persons first seized, and who had been confined in the White Tower, should be examined in his own presence at Whitehall:—This circumstance is supposed to have saved them from the gallows.

During his examination, Blood behaved himself with the greatest effrontery. He not only acknowledged his attempt upon the life of the Duke of Ormond, but he had intended to kill the king himself with a carbine, from among the reeds "by the Thames' side above Battersea," where that monarch often went to swim, but when he had taken his stand for that purpose "his heart was checked by an awe of majesty;" whether it was this flattery, or certain political reasons which influenced the king, the chief culprit and his associates were all subsequently pardoned. Blood, indeed, had property given to him in Ireland, to the amount of five hundred pounds per annum, and was admitted to "all the privacy and intimacy of the Court," a strange result of one of the most extraordinary acts of daring recorded, and to show the perversity of human nature still more strongly, poor old Edwards, who had suffered so much in defence of the crown property, could only obtain a grant of two hundred pounds for himself, and one hundred pounds for his son. The payment of these sums, however, was so long delayed, and the expense of curing the keeper's wounds was so great, that the orders were sold for half the amount in ready money.

The following lines were written by Rochester, one of King Charles's favourites at Court :—

> " Blood, that wears treason in his face,
> Villain complete in parson's gown,
> How much he is at court in grace,
> For stealing Ormond and the crown !
> Since loyalty does no man good,
> *Let's steal the King, and outdo Blood !*"

While on this subject I will relate to you another instance of the robbery of State jewels that occurred in France, at the period of the Revolution, in 1792. It took place, during the night, at the Garde-Meuble, the place in which these precious objects were then kept. Almost all the diamonds, including the famous *Sanci* and the *Regent*, the most valuable jewels of the crown (both of which are described in the chapter on " Diamond mines, and celebrated Diamonds "), were carried off by a band of forty robbers, who ascended the lamp-posts by means of ropes, and gained admission by the windows ; they entered without any obstacle, but were fortunately detected in their descent by a sentinel : one man had his pockets filled with jewels, diamonds, gold, and silver. A present to royalty, from the people of Paris, had been thrown from the window. Another robber, in attempting to escape, threw himself from the colonnade, and was wounded in the head ; his pockets were also loaded with brilliants, and he had a handkerchief filled with diamonds, sapphires, emeralds, and topazes. A few days afterwards, twenty-one of the robbers, armed with daggers, were apprehended, and most of the stolen objects recovered.

I must return, however, to my notice of the British crowns.

Queen Anne wore at her coronation a circle of gold set with diamonds, and was crowned with one called after St. Edward. On the accession of William and Mary this crown was reported to have been dismantled of its jewels; it was, however, "made fit" on that occasion, and for the coronations of succeeding monarchs to the period of George III. A new state crown was prepared for his successor, in which most of the costly jewels of the crown, thus superseded, were employed. The crown of Queen Victoria, which, as I mentioned (page 232), was made in 1838, contains some of the precious stones of the ancient regalia, which was sold by the Commonwealth commissioners, afterwards employed in the crown made for Charles II., and again introduced in that used in the present reign.

The *coronet* of the Prince of Wales is a circle of gold, with crosses and fleurs-de-lys, but it has only *one* arch, decorated with pearls, surmounted by an orb and cross, and bordered with ermine. The three ostrich feathers are added as a badge, said to have been adopted by the Black Prince after the Battle of Cressy, having been the badge of the King of Bohemia, who was slain in that conflict, but the truth of this seems doubtful. The ostrich symbolized justice, and a single feather is traced as a badge to Edward III., and was assumed by different members of the royal family.

The younger sons and brothers of the British sovereign wear as coronet, a circle of gold, bordered ermine, with fleurs-de-lys, crosses and strawberry leaves alternately; nephews of the blood royal have strawberry leaves on their coronets. Princesses-royal wear a circle of gold, bordered with ermine, with crosses, fleurs-de-lys, and strawberry leaves.

I may here notice some remarkable European crowns, and among them especially, the CROWN OF CHARLEMAGNE, to which a high interest is attached as having belonged to one of the greatest, if not the wisest of monarchs. This great potentate was crowned Emperor of the West, by Pope Leo, in the ninth century, in the church of St. Peter's at Rome. His crown is shown in the Imperial Library at Vienna. It is of gold, divided into eight compartments, and weighs fourteen pounds. The first division contains twelve jewels unpolished; the second a figure of our Saviour, sitting between two cherubs; the third, fifth, and seventh, are enriched with gold and gems; in the fourth is the figure of King Hezekiah sitting, and by his side the prophet Isaiah; the sixth has the effigy of King David crowned; the eighth contains Solomon. On the top of the crown is a cross with seventeen jewels in the forepart, and on the top of the cross the inscription "I.H.S. Rex Judæorum." The enamels are very beautiful and curious.

In the year 1160, Frederick Barbarossa had the dignity of "saint," conferred upon Charlemagne, and, in return, despoiled his sepulchre of the crown with enormous treasures, including a golden throne and two golden shields. The crown was afterwards used at the coronation of the German emperors.

The CROWN OF HUNGARY, which was used at the coronation of the present Emperor of Austria, according to an old superstition is said to have fallen from Heaven for the use of St. Stephen. It is a beautiful specimen of ancient art, formed by a broad flat band of fine gold, from whence springs an arch, supporting a cross. It is ornamented with enamels, the largest of which represent the Saviour enthroned; over the medallion is a large heart-shaped amethyst; below it an enormous rough sapphire; four more large sapphires are set at equal distances on the band, all but one being unpolished. There are other enamels, representing the angels Michael and Gabriel, St. George, St. Demetrius, also two portraits, one of the Emperor Michael Dacas, and the other, Geisa, first Duke of Hungary, to whom the crown was sent by the former in 1072. The edges of the circlet are bordered with a row of pearls, and at the back is a large sapphire.

The Iron Crown of Italy is composed of a broad circle of gold, set with large rubies, emeralds, and sapphires, on a ground of blue and gold enamel. The jewels and embossed gold exhibit a very close resemblance to the workmanship of an enamelled gold ornament, inscribed with the name of Alfred the Great, which was found in the island of Athelney, in Somersetshire, about the close of the seventeenth century, and is now carefully preserved in the Ashmolean Museum, at Oxford.

The portion of the crown, however, which is of the greatest traditional interest, is a narrow band of iron, about three eighths of an inch broad, and one-tenth of an inch in thickness, attached to the inner circumference of the circle. This iron band, according to legendary report, was made out of one of the nails used at the Crucifixion, given by the Empress Helena—who was said to be the discoverer of the cross—to her son Constantine, as a miraculous protection from the dangers of the battle-field.

The priests who exhibit the crown, point out as a permanent miracle, that there is not a single speck of rust upon the iron, although it has now been exposed more than fifteen hundred years! The earliest real historical notice of this crown is, that it was used at the coronation of Agilulfus, King of Normandy, in 591.

When the Emperor Napoleon I. was crowned King of Italy, at Milan (May 23, 1805), he, with his own hands, placed the ancient iron crown of Lombardy on his head, saying, "God has given it to me, let those beware who would touch it," thus assuming, as Sir Walter Scott observes, the haughty motto attached to the crown by its early possessors.

The Russian Imperial Treasury in the Kremlin, the "heart," and "sacred place," of Moscow, is particularly rich in crown regalia, and you will be interested in having a few particulars of this vast wealth. In one department is a collection of precious relics, such as the crowns worn by the different emperors and czars, loaded with precious stones, and the dresses worn at their coronations. The crown of Prince Vladimir is surmounted by a golden cross, and enriched with pearls and precious stones, and, until the time of Peter the Great, was used to crown the czars; the crown of the conquered Kingdom of Cazan was placed there, and the crowns of Astracan and Siberia. That of John Alexius has eight hundred and eighty-one diamonds, and under the cross which surmounts it is an immense ruby. The crown of Peter the Great contains eight hundred and forty-seven diamonds, that of Catherine I., his widow, is enriched with two thousand five hundred and thirty-six fine diamonds, to which the Empress Anne added a ruby of enormous size, bought by the Russian ambassador at Pekin. There is, lastly, the crown of unhappy Poland, of polished gold, surmounted by a cross, but with no ornament.

A pleasing anecdote of appreciation for services rendered in the Imperial service, is recorded of the Emperor Alexander I. In the state crown of Russia was inserted a small plate of gold with the name of Kutusoff (who rendered himself famous in rescuing his country from the French). This occupied the place of the most valuable jewel in the crown, which was sent to the warrior by the emperor with a letter, in which he announced to him his elevation to the rank of Prince of Smolensko.

Such is a brief sketch of crowns; it would occupy a multitude of pages to tell the vicissitudes, the throes, the troubles, and the painful career of many who have borne these costly loads. As you turn over the pages of history you will find how few sovereign rulers have enjoyed the peace and satisfaction ironically expressed by the great poet as an appendage to the jewelled bauble :—

> "Do but think
> How serene a thing it is to wear a crown,
> Within whose circuit is elysium
> And all that poets feign of bliss and joy !"

The brightest jewel in a crown is that which is illuminated by a people's love, which is far above all the glitter of precious stones and the pageantry of state. Korner beautifully expresses this idea in a poem which has been thus translated :—

> "At ancient Worms' imperial diet,
> Prince and peer opponent stand,
> High in speech, and flushed with riot,
> Boasting each his native land.
>
> "'Rich and glorious are my mountains,'
> Cried the Saxon prince, 'where shines
> Silver bright as sparkling fountains,
> Bosom'd deep in richest mines.'

"'Luscious hills, luxuriant valleys,
Golden corn, and rosy wine,
Burst my garners, brim my chalice,'
Cried the sov'reign of the Rhine.

"Louis of Bavaria vaunted,
'Mine are domes and turrets high,
Minsters where the mass is chaunted,
Munich's might and majesty!'

"Bearded Everard spake: 'Behold me,
Wurtemberg's beloved lord,
No proud city's walls enfold me,
No bright ore my lands afford;

"Yet there flames a jewel treasur'd.
In my Fatherland, where I
Safe 'midst woods and wilds unmeasur'd
On each subject's lap might lie!'

"Then Bavaria's lord all glorious,
Saxon proud and palatine,
Cry, 'thou bearded chief victorious,
Truth, the gem of gems, is thine!'

"And the crowned Kaiser rising,
Shouts amain, 'a health! a health!
To Count Everard—justly prizing,
Loyalty, the monarch's wealth!'"

CHAPTER XVIII.

COMMON STONES.

"'Tis very pregnant,
The jewel that we find, we stoop and take it
Because we see it; but what we do not see,
We tread upon, and never think of it.
Measure for Measure.

FROM the costly gems that adorn the brow of a monarch, and add brilliance and beauty to innumerable objects of art that attract and gratify the eye, it may seem a great descent to fix our attention upon such an ordinary trifle as a COMMON STONE, such as we are apt to cast aside in our path with indifference as unworthy of notice, and yet I have no hesitation in placing it among the "Treasures of the Earth," for in real utility it far exceeds all the splendid jewels of which you have been reading.

It has been truly said—I think by Bernardin St. Pierre —"there is no picking up a pebble by the wayside without finding all nature in connexion with it," and so, in the history of a common stone, we have one of the great marvels of creative power unfolded to us, inviting research, and filling our minds with humble adoration of the great Architect of the Universe, who raised this wonderful world of ours into existence. There are, indeed, "sermons in stones," the truth of which you will experience later, when reflection leads you

"To see, and hear, and breathe the evidence
Of God's deep wisdom in the natural world."

I am not going to weary you with any details on the structure of the earth, the relative situations of rocks and minerals, of their connexion with each other, and the changes they have undergone, and are still undergoing. Such is the province of that most interesting of all the sciences, Geology (so called from two Greek words, *ge*, the earth, and *logos*, reason, or discourse), which will hereafter invite you to a deeper knowledge of the world you inhabit. I will merely confine my remarks to a few simple objects which you may often pass without thought or observation. Let us take, for instance, a piece of granite (so named from its granular structure), which is common enough; indeed, you cannot help seeing the kerb-stones that border the pavements of the streets of London and many large towns. You will surely regard this piece of grained stone with greater interest when you know that the rocks of which it was a portion, form the chief material of which the crust of the earth is made, and the foundation on which all other rocks are placed; also, that long ages before man was a dweller in this world, the great massive rocks of granite spread themselves over the earth, from a period that the mind cannot possibly conceive. Consider, too, how these rocks, so widely distributed, form the most beautiful objects that the eye can gaze upon, constituting the mountain scenery of most parts of the world, assuming the most grand proportions and elegant shapes. In the vicinity of Mont Blanc the granite rocks assume lofty pyramidal peaks that rise in enormous spires. The Aiguille (so called from its needle shape) de Dru is, perhaps, one of the most remarkable granite mountains at present known; the upper part in spire rises above its base, nearly to a point, in one solid shaft more than four thousand feet; the summit is eleven thousand feet above the level of the sea.

I may also remind you how valuable granite is for many purposes, on account of the great durability of some of its varieties. It is thus employed on works requiring great strength and resistance from the wear of time, and other causes; bridges are made of it (you may have remarked the fine red coping-stones of Waterloo bridge, and the white granite balustrades). Public buildings, large mansions, and engineering-works are also made of granite. On account of its hardness it cannot be cut like the majority of building stones, but is worked first with large hammers, and then with pointed chisels.

The temples, statues, and important buildings of the Egyptians were made of the red granite of that country; granite taken from the quarries of Syene was also partially employed in the erection of the Pyramids, which were considered one of the seven wonders of the world. In the British Museum you will see some fine specimens of granite-work from the ancient land of the Pharaohs. The granite best known for ornamental purposes in our country, are the grey Aberdeen and the reddish-coloured Peterhead descriptions.

I will now refer to another object of observation, a very abundant substance in nature, entering more or less into the composition of rocks. I allude to LIME. This is a compound of a metal called *calcium* (a name given to it by Sir Humphrey Davy), with oxygen, one of the elements of the air, and, as you know, is of important use in agriculture, besides being employed in all our buildings. Now, when lime is combined with carbonic acid (which occurs in a variable quantity in all natural water, for it is absorbed by water in its passage through the air, as well as through the earth), it forms carbonate of lime, which is the most abundant compound of it, for under the name of limestone, chalk, &c., it constitutes immense deposits of rock in every part of our globe.

Every one is familiar with the appearance of this latter substance, CHALK, but there are not so many who take the trouble to examine it with a view to improve their knowledge. I have already (page 29) explained to you the wonders that are seen through the microscope in a lump of coal; if you view a piece of chalk through the same medium you will observe equally interesting results. It is composed of an impalpable powder cemented together into a more or less hard mass. It is what is termed *amorphous*, or, without form. The microscope will show you that this apparently impalpable powder consists in a great part of animalcules, together with minute shells, so exceedingly small that a *million* distinct structures are computed by Ehrenberg to be contained in the space of a cubic inch! These organic remains constitute nearly half the bulk of the chalk of Northern Europe, and exceed in proportion that of Southern Europe. The portion of these chalk formations that is not organized was originally shells, which having become decomposed, now form a cement for the organic remains, uniting them together in one compact mass. The larger shells are perceived when the sediment obtained by brushing chalk into water is closely examined. If you should wish to try this experiment, you can adopt the plan recommended by Ehrenberg, which is very simple, and highly interesting in its results. A drop of water is first placed upon a thin slip of glass, and then upon the water as much scraped chalk must be spread as will cover the fine points of a knife. After leaving the chalk to rest for a few seconds, the finest particles suspended in the water must be withdrawn, together with most of the fluid, and the remainder suffered to become perfectly dry. This sediment must now be covered with Canadian balsam, and the glass held over a spirit lamp until the balsam becomes slightly fluid, without froth or air bubbles. In this state it is kept for a short time, until the balsam thoroughly penetrates every part of the sediment flowing into the chambers and cavities of the microscopic shells, and causing their structure to be more readily detected. When a preparation thus made is magnified three hundred times, the chalk is seen teeming with minute organic forms, the peculiarities of which are so clearly revealed that the observer is able to arrange and classify them with the utmost ease. The organic remains in chalk are exclusively marine; the teeth, palate, and scales of fishes occur frequently. The great preservation in which some of the most delicate organic remains are frequently found render it probable that chalk was deposited in a deep and tranquil sea.

I have remarked on the grandeur and beauty of the granite mountains; there is also much to gratify the eye in the white sea-cliffs to which many a longing eye turns on leaving the shores of Old England, or returning from a long sea-journey to their homes once more. Chalk gives an important feature to the scenery of our country in the smooth and flowing outlines of its hills. As I have also explained, it occupies an important position in geology.

The beautiful marble of which so many specimens of the sculptor's and decorator's art are made is the same material, chemically speaking, as chalk. The difference is one of form, and not of nature. An examination of a piece of white marble shows that it contains a mass of minute crystals, like a piece of lump-sugar, cemented together. When a rock composed of carbonate of lime is distinct crystalline, and sufficiently hard to retain a polish, it is called marble.

In order to explain more clearly the minerals I wish to bring to your notice, it is necessary that I should give some explanations that will make you better acquainted with them, and this I will endeavour to do in as simple a manner as the subject will allow. What is called in geology the *primary*, or first strata (extensive layers of any mineral substance), consists of rocks lying in alternate beds, in which no trace of animal remains are found; they are also of great thickness, and they are the lowest rocks that have been reached. The unstratified rock most usually associated with the first layers is granite—of which you have been reading—of different varieties, which usually lies under them in great masses, and bursting through, forms the lofty mountains and pinnacles I have described.

Above, and in contact with these rocks, is another group of strata, which has some resemblance to those below them; these have been called *transition* layers, because they were supposed to form a step, or transition, from the primitive state of the globe to that condition when it had begun to be inhabited by living bodies. In strictness, they form the lowest members of the next great division of the strata, which is named the *secondary*. These formations comprise all the regular strata, or layers, that cover the transition rocks and coal measures, and terminate with chalk. These consist of vast masses of sandstone, and fragments of different rocks, and of numerous calcareous beds, separated by beds of clay and sand. The limestones abound in remains of marine animals and their shells, but relics of fresh-water animals occur in some of the beds, and parts of petrified vegetables are also found, proving the existence of dry land when the layers of rocks were deposited.

This secondary strata covers a large portion of the habitable globe, and are the sub-soil of the most fertile districts in our own country, and in various parts of Europe.

The *Tertiary*, or third formation of rocks, comprise all the regular layers of limestone, marl, clay, and sandstone that have been deposited after chalk. It is only since the commencement of the present century that they have attracted the notice of geologists. It is now discovered that these formations are widely spread over the surface of the globe. The first circumstance which indicated that the tertiary beds were distinct from the secondary was the discovery that many of these beds contain the bones of the higher order of animals, as perfect in their organization as any of the existing species of land quadrupeds. The tertiary beds were also remarkable for presenting frequent alternations of beds containing the remains of marine animals and plants, and fresh water shells—hence, the latter were called fresh-water formations.

The tertiary strata form the *outer* crust of the globe, and have everywhere been subject to wear and breakage from torrents and inundations that have swept over parts of its surface, and transported the fragments into distant countries, or into the ocean.

Having thus briefly explained a few of the elements of geology, you will be able, I hope, to understand what I tell you respecting FOSSILS, to which I have already alluded in the description of a piece of chalk. The term *fossil* (from the Latin *fossilis*) means anything dug out of tha earth, and used to be applied to all minerals, but its application in geology is to organized (various parts co-operating together) bodies contained in the loose or solid beds composed in the crust of the globe, and which are, for the most part, converted into stone. By the aid of these bodies geologists are able to find out that beds of limestone, existing in various localities, though different, perhaps, in appearance, belong to the same age or period of formation.

How wonderful is the fact that the vast mountains of calcareous matter (combinations of lime with carbonic acid) which occur in different parts of the world, owe their origin in general to the destruction of marine animals and their shells, which, in long process of time, formed those extensive and accumulated heaps.

"For in vast shoals beneath the brineless tide,
On earth's firm crust, testaceous tribes reside;
Age after age expands the peopled plain,
The tenants perish, but their cells remain;
Whence coral walls and sparry hills ascend
From pole to pole, and round the line extend."

The study of fossils is one of the most absorbing and deeply interesting that you can possibly cultivate. "They reveal to us the wonderful fact that God has created different species of animals and plants, at successive and widely different periods of time, and that many of those that existed in the earlier ages of our globe became extinct before the formation of others; that, before man was called into existence, innumerable descriptions of living beings had covered the surface of the earth for a series of ages to which we are unable to fix any limit.

We further learn that a very large proportion of these creatures, of the later periods, had become extinct, and had been replaced by the animals which now exist before the creation of our first parents. When that great event took place, the crust of the earth had already undergone numerous changes. We are also taught by the study of fossils that, prior to the creation of man, there existed a totally different condition of our planet, in so far as regards the distribution of land and water, from that which now exists; that where there are now vast continents there must have been deep seas, and that extensive tracts of land must have occupied those parts of the globe which are now covered by the ocean. In many parts of the interior of our continents there must have been vast lakes of fresh water, which were drained by subsequent changes in the form of the land which bounded them, and were replaced by wide valleys, long antecedent to the existence of man. Thus in the very heart of France, in a district along the banks of the river Allier, of which the town of Vichy may be taken as the centre, vast strata, full of fresh water shells, prove that there must have existed for many ages a lake nearly one hundred miles long and twenty miles in average breadth."—*Knight's "Store of Knowledge."*

Lyme-Regis, in Dorsetshire, is particularly rich in fossils. The cliffs, four miles in length, are of limestone associated with clay, called lias-clay, with bituminous (a variety of fossil inflammable substances) and carbonaceous matter, also sulphuret of iron, or iron pyrites,—an abundant mineral, too much so in many coal-fields, the action of water and air changing it into vitriol, by which so much heat is evolved that the coal is frequently kindled by it, mines become unworkable, and the progress of the fire can only be stopped by building up portions of them to cut off the access of air, or by the admission of a plentiful supply of water. I mention this more particularly to explain a curious event that occurred at these cliffs in August, 1531. They then became the scene of a vast conflagration. The flames were not visible by day except the sun shone, when the cliffs appeared, at a distance, as if covered with pieces of glass which reflected the rays; at night the flames were visible at a distance, but when the spectator drew near he could only see smoke. About the middle of the last century a similar circumstance occurred, and the conflagration lasted several months. The cause of these fires arose from the lias clay falling in masses from the cliffs, and, when moistened by sea-water, igniting spontaneously.

At the beginning of the present century little was known of the rare fossil treasures that had been encased in the cliffs at Lyme Regis for many ages. A few persons gathered what they called *curiosities*, in the shape of pebbles and stones. A coal-merchant, of London, John Crookshank, was the first collector of any fossils of value. He went there in search of them, with a long pole, like a garden hoe, and found many specimens of petrified vertebræ, or spines of animals. A carpenter named Richard Anning became associated in this search, but such was the want of intelligence at this time that the fragments they found were considered to be and named "bones of crocodiles, backs and jaws, ladies' fingers, John Doreys, salmon," &c.

After the death of Richard Anning, his daughter Mary, then *ten* years of age, had her curiosity attracted to these fossils. One of her first acquisitions was an *ammonite*, a shell divided into chambers, and thus named from its resemblance to the horn of Jupiter Ammon. From its likeness to a snake, it was supposed formerly to be a petrified serpent, thus changed by the miraculous power of the Lady Hilda, first abbess of Whitby Abbey. To this superstition Sir Walter Scott alludes in "Marmion" (canto ii.):—

> "And how, of thousand snakes, each one
> Was changed into a coil of stone,
> When holy Hilda prayed.
> Themselves within their holy bound
> Their stony folds had often found."

The further history of Mary Anning is instructive, for it teaches us how the pursuit of science in early life may lead to future distinction. The daughter of the poor carpenter at Lyme Regis will ever be remembered, as a humble but useful pioneer in geological knowledge.

As Mary Anning was returning with her fossil, a lady in the street seeing it, offered her half-a-crown for it, which she accepted, and from that moment determined to go down upon the beach and thus get her living. Four months afterwards, in 1811, she saw among the ledges in the rocks a projecting bone of some animal. This "crocodile" (as it was then considered) was traced by her as it lay, and dug out by men whom she employed. It proved to be the skeleton of an *ichthyosaurus* (so called from the character of the animal, partaking at the same time, of the nature of a fish and of the lizard tribe, *ichthus* and *saura* being two Greek words signifying fish and lizard). Lyme Regis has been the repository for the remains of this remarkable reptile which inhabited the sea during the deposition of the secondary strata. The body was shaped like that of a fish, the limbs were developed into paddles, and the tail, long and lizard-like, was furnished, it is believed, with a fleshy fin. The head was large and had a long pointed snout, somewhat resembling the crocodile, and the jaws with a large number of powerful teeth. Their principal food consisted of fishes. The whole length of some specimens is about thirty feet.

The eminent geologist, Robert Bakewell, was inclined to believe that the ichthyosaurus, or some similar species, is still existing in the present seas, and cites the appearance of the great sea-serpent on the coast of America, as a probable instance.

The ichthyosaurus discovered by Mary Anning, and which has, for many years, proved an object of interest to the British Museum, was sold by her to Mr. Henley, at Lyme Regis, for about twenty pounds. The clever and intelligent finder added to her other talents great judgment in extracting the fossils, and preserving them from fractures, and thus the numerous specimens she found had additional value and interest.

In 1823, the first remains of another extraordinary marine animal were found imbedded in the cliff at Lyme Regis, the *plesiosaurus* (so called from its near approach to the lizard tribe), *plesios*, being Greek for near. Specimens of this fossil reptile are also to be seen in the British Museum. It has a considerable resemblance in the body to the ichthyosaurus, but the head is much smaller. The late Dean Buckland thus describes it "to the head of a lizard, it united the teeth of a crocodile; a neck of enormous length resembling the body of a serpent; a trunk and tail having the proportions of an ordinary quadruped; the ribs of a chamelion, and the paddle of a whale."

Some fragments of the bones of a reptile of gigantic proportion were discovered by Dean Buckland in a quarry near Woodstock. According to the opinion of Cuvier, who examined them, they must have belonged to an individual of the lizard tribe, measuring forty feet in length, and having a bulk equal to that of an elephant seven feet high. This fossil animal was called *Megalosaurus*, or great lizard.

But of all the remains of primitive lizards that have been discovered—and this class I may observe, is the most interesting of all fossils whatever—the most remarkable is that called the *pterodactyl* (from the Greek, wing-finger), specimens of which may be seen at the British Museum. It had the wings of a bat, the neck of a bird, and a head furnished with long jaws, full of teeth. The eyes were of enormous size, apparently enabling the animal to fly by night. From the wings projected fingers terminated by long hooks, to enable it to creep or climb, or suspend itself from trees. Cuvier pronounced this animal to be the most extraordinary extinct creature known, and the one, which, if restored to life, would most astonish us by its singularities of aspect and habits. In allusion to its powers of adapting itself to so many elements, the words of Milton have been applied to it, describing—

> "The fiend,
> O'er bog, and steep, through straight, rough, dense, or rare,
> With head, hands, wings, or feet, pursues his way
> And swims, or sinks, or wades, or creeps, or flies."

The great naturalist Baron Cuvier was the first who successfully applied the knowledge of anatomy to ascertain the forms of fossil animals. He gives us an account of his own feelings when he first became able to arrange the bones of such species of unknown animals found in the lime quarries near Paris :—" When the sight of some bones of the bear and elephant, twelve years ago, inspired me with the idea of applying the general laws of comparative anatomy to the reconstruction and discovery of fossil species,—when I began to perceive that these species were not perfectly represented by those of our day, which resembled them the most,—I did not suspect that I was every day treading upon a soil filled with remains more extraordinary than any that I had yet seen, nor that I was destined to bring to light whole genera of animals unknown to the present world, and buried for incalculable ages at vast depths under the earth. It was to M. Veurin that I owe the first indications of these bones furnished by our quarries, some fragments which he brought me one day having struck me with astonishment, I made inquiries respecting the persons to whom this industrious collector had sent any formerly; what I saw in these collections served to excite my hopes and increase my curiosity. Causing search to be made at that time for such bones in all the quarries, and offering rewards to arouse the attention of the workmen, I collected a greater number than any person who had preceded me. After some years I was sufficiently rich in materials to have nothing further to desire; but it was otherwise with respect to their arrangement and the construction of the skeletons, which alone would conduct me to a just knowledge of the species. From the first moment I perceived that there were many different species in our quarries, and soon afterwards, that they belonged to various orders, and that the species of the different orders were often of the same size, so that the size alone rather confused than assisted my arrangement. I was in the situation of a man who had given to him in a mass, the mutilated and incomplete fragments of a hundred skeletons, belonging to twenty sorts of animals, and it was required that each bone should be joined to that which it belonged to. It was a resurrection in miniature, but the unchangeable laws prescribed to living beings were my directors. By the aid of anatomy each bone, each fragment, regained its place. The feet were conformable to what the teeth had announced, and the teeth to the feet; the bones of the legs and thighs, and every thing that ought to re-unite these two extreme parts were conformable to each other. In one word, each of the species sprung up from one of its elements."

From this simple and very interesting expression of feeling by one of the greatest scientific men the world has produced, you will perceive how genius, persevering and searching, triumphs over every difficulty.

"Before the time of Cuvier who would have imagined that at Montmartre were hidden thousands of quadrupeds of the older tertiary periods? Had any one," adds Mr. Boucher, "asserted their existence, and especially the fact that they represented species of animals long extinct, would not everyone have refused belief?"

Cuvier opened the way which other eminent men have trod, and none with more distinction than the anatomist whose name sheds lustre on our country, Professor Owen. Cuvier had, as he states, a fertile field for operation. The southern parts of Paris are built over beds of limestone rich in fossils. Cuvier describes it as the most remarkable that has yet been observed, both from the succession of different soils of which it is formed, and the extraordinary fossil remains which it contains. Millions of marine shells, which alternate regularly with fresh water shells, compose the principal mass. Bones of land animals, of which the species are entirely unknown, are found in certain parts; other bones, remarkable for their vast size, and of which some of similar species exist only in distant countries, are found scattered in the upper beds. In one word, no country can afford more instruction concerning the last revolutions which have terminated the formation of the present continent.

These beds of limestone have been so extensively quarried as to have become a mere network of vast caverns, which, in some cases, scarcely afford sufficient support to the houses above. The quarries were first converted into catacombs in 1784, when the bones of the dead were collected in this place from the ancient cemeteries of Paris.

It was only known as a popular tradition that these quarries extended under great part of Paris, until the year 1774, when some alarming accidents aroused the attention of the Government. They were then surveyed, and plans of them taken, and the result was the frightful discovery that the churches, palaces, and most of the southern parts of Paris were undermined, and in great danger of sinking into the pit below them. A special commission was appointed, and on the very day it met, a house in one of the streets sunk ninety-one feet below the level of its courtyard. Engineers were at once engaged to examine the whole of the quarries, and prop the streets, roads, churches, palaces, and buildings of all kinds, which were in danger of being engulphed. One set of workmen were employed in this curious service, another in exploring the labyrinth of excavations, some of which were under the others, and opening galleries between them, that the extent of the peril might be known; and to prevent future evils of the same kind, all the quarries which were still in use, in the environs of Paris, were placed under the inspection of the Commissioners, in order that they might be worked on some safe plan; never had any men a more arduous or important commission. The pillars which had been left by the quarrymen, in their blind operations, without any regularity, were, in many places, too weak for the enormous weight above, and in most places, had themselves been undermined, or, perhaps, originally stood upon ground which had previously been hollowed. In some cases they had given way, in others the roof had dipped and threatened to fall; and, in others, great masses had fallen in. The aqueduct of Arcueil passed over this treacherous ground; it had already suffered some shocks, and if the quarries had continued to be neglected, an accident must, sooner or later, have happened to this water-course, which would have cut off its supply from the fountains of Paris, and have filled the excavations with water.

Repairs were forthwith commenced, and promptly completed, and a portion of the old quarries was devoted to receive the bones of the dead. This took place in April, 1786; the remains of the dead were removed at night in funeral cars, covered with a pall, and followed by priests, chanting the service of the dead. When they reached the catacombs, the bones were shot down a well, and the rattling and echoing which they made in their fall, was as impressive as ever was heard by human ears.

Thus the limestone quarries that had supplied the materials for building the superb monuments, palaces, and houses of Paris, became one huge charnel-house, which it now remains! Calculations differ as to the number of bones collected in the catacombs, but it is certain that they contain the remains of, at least, *three millions* of human beings!

But to return, I have shown you the wonderful treasures of the ancient world, preserved in limestone and chalk. Let us now examine a piece of FLINT, which you must well know. The gravel in the road or beneath your feet consists principally of this substance, which has been rounded by wear and exposure to air and moisture, giving it, for these reasons, a yellowish red colour. Dark flints are most common in chalk, in which it principally occurs imbedded, forming irregular masses of various sizes, and, often, strange shapes. Now, think for a moment how valuable is this plain-looking common stone. Not all the jewels in Nature's brilliant casket has proved more useful to mankind. To its hard condition Shakspere beautifully alludes:—

> "Weariness
> Can snore upon the flint, when restive sloth
> Finds the down pillow hard."

thus contrasting the repose of labour with the troubled slumber of the effeminate.

Flint used to be commonly used with steel for igniting tinder, and, by this means, only a few years ago, our fires were usually lighted, an operation now much more effectually aided by lucifer matches. Boileau, the French poet, says—

> "In many a spark,
> Forth leaps the sprightly fire against the dark,
> The tinder feels the little lightning hit,
> The match provokes it, and a candle's lit."

In the application of gun-flints formerly (now superseded by percussion-caps), how the mind is carried back to many issues of battle that decided the fate of nations. We trace flint even to primitive times, when it was used for making sharp weapons and cutting instruments; knives, axes, arrow-heads, &c., are among the most interesting relics of rude antiquity. In some cases the flint has been roughly fashioned into something like the required form by two or three blows; in others, after being duly shaped, it has been ground smooth, and has even been polished as well as could be done in modern times. You know how invaluable flint is in the making of glass, which is now so extensively employed, not only adding to our comforts, but gratifying the eye with the beautiful ornamentation of which it is capable.

In flint, soda, potash, lime, and oxide of lead, we have nearly all the elements of which glass is made. Flint-glass, called by the French *crystal*, owes its English name to the large proportion of flint it contains. It is powdered flint which gives whiteness and solidity to fine earthenware. The flints, thus used are burnt in a kiln, slaked to loosen them, and then ground in a mill.

The earth *silica*, or flint, abounds in almost every description of vegetable matter. By *earths* are meant the small number of bodies possessed of common properties, of which consists the various kinds of moulds on which vegetables grow, as well as the stony or crumbling masses that form mountains, valleys, and plains, and are spread as a crust over the earth. Silica, or flint, abounds especially in the grasses. In the Dutch rush it is so plentiful that the plant is used by turners to polish wood, bone, and even brass. It forms so considerable a portion of wheat-straw that when these are exposed to the action of the blow-pipe, it unites with the potash also in the straw, and forms an untransparent glass. It is almost, if not equally, as generally present in all plants, as lime.

While on this subject it will interest you to know that silica constitutes two thirds of *asbestos*, a mineral termed "imperishable," because of its incombustible nature. It was valued by the ancients for wrapping up the bodies of their dead before they were placed on the funeral pile to be burnt. They discovered a method of drawing the fibres of the minerals into thread, and afterwards weaving it into cloth. In consequence of its fire-proof character it preserved the ashes of the body from mixing with those of the funeral pile. Several pieces of this antique cloth are exhibited in the mineralogical department of the British Museum.

Flint is essential in the making of good mortar for buildings; it is the most durable article in the state of gravel for making roads, and it is of great use in many chemical furnaces and utensils.

In flints also we have the presence of numerous fossils —entire masses are composed of the petrified remains of beings as wonderful in their structure as any of the colossal forms of animal existence. But besides the invaluable lessons of creative power, that enable us to form an estimate of the condition of the globe through past ages, that fossils teach us, they are not merely the objects of curious regard, but are made the means of refreshing and invigorating the earth as a rich and productive manure.

"It was said of old, that the Creator measured the dust, and weighed the water, when He made the world. The first quantity is here still, and though man can gather and scatter, move, mix, and unmix, yet he can destroy nothing; the putrefaction of one thing is a preparation for the being, and the bloom, and the beauty of another. Something gathers up *all* fragments, and *nothing is lost.*"

Thus Darwin writes,—

> "Hence when a monarch or a mushroom dies,
> Awhile extinct, the organic matter lies,
> But as a few short hours or years revolve,
> Alchemic power the changing forms dissolve;
> Emerging matter from the grave returns,
> Fills new desires, with new sensation burns."

From the "Technichologist," we learn some curious particulars about the *trade* in fossils for manure. *Coprolites* (from the Greek words meaning *dung* and *stone*) are, I should tell you, the fossilized excrements of animals discovered in the secondary and tertiary strata of the earth's crust which I have partially explained to you; as they are found to contain a large quantity of phosphate of lime (a compound of acid and lime which is the basis of all bones) they form a valuable manure. In commercial meaning, coprolites include also bones, teeth, and other fossil relics of animals. It is chiefly in the counties of Cambridge and Suffolk that these are obtained. It is supposed that part of South-East Suffolk was once a large arm or estuary of the sea, wherein dwelt, long ages ago, the monsters of the deep, several of which I have described to you, and that their organic remains have been buried up by some great convulsion of nature. At the distance of twelve miles from the present boundary of the sea, parts of land animals and vegetables are found. It is probable that the beasts of the forest preferred the margin of the water; their bones, with trees, fruit, and seeds, all having been washed into the sea. That it was once water, is proved by the shells and the great quantity of cement-stone that are found of exactly the same description as that dredged for on the coast.

Coprolite is a species of fossilized guano; it looks like very dark oblong pebbles, rounded and polished by the water. It is very brittle, and the interior is dullish brown, slightly tinged with yellow. Some of them contain small teeth and bones which shew they belong to some carnivorous animal. These fossils were first discovered in the part of the country I have last mentioned, about the year 1846. A celebrated artificial manure manufacturer was walking with a friend on Bawdsey Beach, and picked up some coprolites that had been washed out of the crag cliffs. Finding they contained manuring qualities he requested his companion to employ some children in picking them up. This continued about two years, when one day the children had taken out so many from under a portion of the cliff, that a large mass fell upon a little girl who was killed. At the inquest, the jury wanted to know what coprolites were, and thus the discovery of their locality was made public. The consequence was that the farmers found these crag-pits were full of the fossils, and several set to work and sold the produce to the original finder at one pound per ton. The manufacturer had obtained a patent, which was infringed, and in an action at law he lost his privilege, and then everybody was allowed to make use of it. The price rose with the demand, and this was an inducement to continue the search. Fine crops of wheat were dug up, buildings were undermined, cottagers' turned over their gardens, and surveyors the roads. Some farmers had upwards of fifty workmen employed in collecting the valuable mineral, and some parts of the country had the appearance of an Australian gold-field. Several persons made their fortunes at this early stage of the coprolite mania.

The coprolites are generally found within two miles of the banks of the Orwell, or Deben rivers, and lie in beds from ten to five hundred yards in width, and from two to forty feet in depth. After digging through the top-soil, a light sand is discovered, and then some white crag which deepens to red ; next, a strata of dark crag, interspersed with every variety of sea-shell, under which, and above the loam, the vein of coprolites is found, varying from six to thirty-six inches in thickness. It is generally mixed with crag, cement-stone, shells and water.

The refuse of the coprolites not used for manure or for adulterating guano, is, you will be surprised to know, employed in the manufacture of *fine wares*, and some particular kind of paint.

Mr. Simmonds, in his excellent work on "Waste Products," tells us that these extraordinary "diggings" have opened such a field for geologists and scientific men as does not exist in any other part of the kingdom. He mentions, among numerous and rare fossil remains found at these diggings, those of the whale and the saurians I have described to you, besides all kinds of fish. There are also the bones of land animals, such as the mastodon, elephant, rhinoceros, deer, wild boar and birds, but not so plentiful as the others ; there are a few fossil shells, and a great variety of beautiful coral. The consumption of the Cambridge and Suffolk coprolites amounts to nearly fifty thousand tons. You can therefore readily imagine what a great boon these fossils are to the agriculturist and the manufacturer.

I must now conclude this long chapter, not however willingly, for there are, as you have doubtless found—

"Things curious, yet unfamiliar,"

even in "common stones," which I would gladly, as far as ability allows, enlarge upon if space permitted. I trust that what you have read will induce you to study the subject much more deeply, and that you will make Geology a favourite science—remembering what Milton says,—

"Thy desire, which tends to know
The works of God thereby to glorify
The great Workmaster, leads to no excess
That reaches blame, but rather merits praise
The more it seems excess; * * *
For wonderful, indeed, are all His works,
Pleasant to know, and worthiest to be all
Had in remembrance always with delight."

CHAPTER XIX.

THE QUICKSILVER MINES OF ALMADEN, CALIFORNIA, AND IDRIA.

One of the most valuable metals employed in a variety of operations connected with science and the arts is that called *mercury*, or *quicksilver*, the use of which, among many others, you must have observed frequently in *barometers* and *thermometers*. In that form its density or weight, and regularity in expanding or contracting by the increase or diminution of temperature, give it a preference over all liquids for those purposes.

A most important application of quicksilver, also, is that by which gold and silver are extracted from the substances in which they are found, by the process of what is called *amalgamation*, that is, mixing with them, and forming fluid solutions of those metals, separating the earthy portions, with which, being metallic, it will not mix. In this manner quicksilver will unite very readily with almost all metals, and when added in a considerable quantity forms a paste which can be kneaded, and is called in that state an *amalgam*. This is squeezed through a piece of leather, in which the gold and silver remain, with a certain portion of the quicksilver, and the former are freed from the latter by means of fire, which dissipates the mercury. This amalgam made with gold serves also for gilding metals (water gilding), but as this process is attended with dangerous consequences to the health of the workmen employed, from the poisonous qualities of the mercurial vapours, the gilding of metals is now effected by means of electricity. Nearly all the gilt articles manufactured at Birmingham are now gilded by the process patented by Mr. Elkington.

For the bright and useful looking-glasses that adorn our rooms we are also indebted to quicksilver. The reflecting property of these mirrors is due to the amalgam of mercury and tin which is fixed in the hinder surface of the plate of glass. Sheet tin is laid on an even table of marble, and over this quicksilver is spread; the glass is then laid upon this, and pressed down with heavy weights, to squeeze out the excess of the mercury. The table being raised a little the mercury runs off, and the glass plate being removed the amalgam is found adhering to it.

The percussion caps used for firing are filled with a preparation of mercury, which explodes by gentle heat or the least friction. Two grains and a half of this mercurial powder, mixed with a sixth part of that weight of gunpowder, is the quantity for one percussion cap.

Indeed, the uses of quicksilver are so numerous that I can only allude to a few besides those I have mentioned. It is indispensable in the construction of philosophical instruments in anatomical preparations. Mercury is also the basis of many powerful medicines, and various chemical preparations are made with it. Some of these are deadly poisons.

When perfectly fluid quicksilver feels very cold, as if wet, but does not adhere to the fingers. It has neither taste nor smell, and has the brilliant whiteness of silver. When pure it neither rusts nor tarnishes by exposure. After platinum and gold it is the heaviest of the metals. Here, in our climate, it is generally fluid, but in the cold northern regions it not unfrequently freezes in severe winters. When solid, quicksilver crystallises, and is so malleable that it may be beaten into leaves as thin as paper. This, indeed, was actually done at Hudson's Bay, the anvil and hammer having been previously reduced to the same low temperature. When some of this mercury was plunged into a glass of warm water the metal became fluid, and the water froze with such rapidity that the glass was shivered into a thousand pieces.

Quicksilver is so easily divided that it may be strained by moderate pressure through the pores of leather, and this is a very ordinary way of purifying it from dust.

It is found in its native, or fluid state, in most of the mines of the other mercurial ores, and in the form of small drops attached to the rocks, or lodged in the crevices of other ores. It is thus found in some parts of Europe; in Idria, Upper Hungary, Spain, Italy, &c.; also in Peru and China, where there is a singular manner of importing it. This is by means of a bamboo cane, which, as you know, is hollow. The stick is cut at the joints, so that the intervening space between each joint affords a reception for the mercury, which is poured in through a hole made in the joints. When this is done the holes are closed up with melted pitch, and the bamboo is wrapped around with a cloth steeped in pitch. One of these canes will contain twenty-six pounds of quicksilver.

Native amalgam of mercury that is found united with silver is solid, and even brittle, which latter characteristic distinguishes it from native silver. It is discovered chiefly in small rounded pieces, and is rare, being found only in Hungary, Sweden, Siberia, and a few other places. A moderate heat is sufficient to dissipate the mercury from the silver. It whitens the surface of copper when rubbed upon it, which silver does not.

Sulphuret of mercury, cinnabar, or *vermilion*, as you would be more likely to know it, is a red mineral of various shades, and the most abundant of this valuable production, and from which almost all the mercury of commerce is obtained. Besides a variety of uses to which vermilion is applied, you are aware of its value in painting, and in colouring the best qualities of sealing-wax. It is used in the arts by fusing sulphur with six times its weight of mercury, and this mixture, when reduced to powder, becomes vermilion.

To extract the metal from the cinnabar, this ore is mixed with quicklime, and then submitted to heat. The lime combines with the sulphur, and the quicksilver which is raised from the mixed mass is collected in receivers.

Quicksilver is so elastic when in a state of vapour, that it is capable of bursting the strongest vessels. A person pretending to fix mercury, had enclosed some of it in an iron box, closely shut. When the mercury became heated, it burst the iron into fragments, and disappeared in invisible vapours. A fulminating powder has been made with this metal for blasting rocks, as its immediate force is much greater than that of gunpowder, though it does not extend so far.

The quicksilver mines at ALMADEN, in Spain, are the richest and most valuable now known. There are three great veins of this mineral, called St. Nicolas, St. Francisco, and St. Diego, and the entire depth of the workings exceed a thousand feet. So little appearance is there of any diminution in this extraordinary deposit, that it increases, both in quality and quantity, as the workmen descend, and the finest qualities are quite at the lowest part. The arrangements connected with this mine are all on the largest scale, and no expense is spared in working it. The arches and pillars to support the roof of the galleries are of solid masonry, the use of wood for these purposes having been abandoned in consequence of accidents. Several thousand men are employed in this mine during the full season. Those who work below are divided into three watches, each of which works about six hours out of twenty-four. The health of the miners employed in extracting this most unwholesome mineral varies very much, but on the whole they are seriously affected by the exhalations and the heat of the lower workings. This may easily be imagined when it is stated that at the low workings the quicksilver runs down the walls, and the heat is considerable, while the ventilation is naturally deficient. The coppery taste of the mercury is sensible on the tongue, and greatly affects the men when they are working hard and get heated, although almost naked. These miners come from all parts, some even from Portugal. After the winter's work, most of them are much altered in health and appearance, but a change of air soon restores them, and, in most instances, they return again to their work. Everything depends upon care and attention to diet; those who live freely, especially those who indulge in wine, fall victims to the disorders generated by the pernicious mineral, whilst those who are attentive in cleansing their persons immediately after leaving work, and live temperately, using a good deal of milk, attain the usual ages of man in that country. The quicksilver mines of Almaden are of great antiquity. Seven hundred years before the birth of Christ the Greeks imported the metal from thence, and Rome, in the time of Pliny (who was born twenty-three years before the Christian era), received seven hundred thousand pounds weight, annually, from the same mines.

Though these have been worked pretty constantly during so many centuries, the supply seems exhaustless. Up to the recent period of the discoveries of quicksilver in California, the mines of Almaden had exclusively supplied the markets of Europe and America. The amount now extracted from the Spanish mine is twenty-nine thousand three hundred and sixty-eight hundredweight, sufficient to employ from three thousand to four thousand miners. But the actual consumption of mercury at present does not exceed sixty-one thousand three hundred and five hundredweight, which are thus divided,—twenty-three thousand six hundred and twenty-one for America; nineteen thousand nine hundred and sixty-eight for Mexico; and seventeen thousand seven hundred and sixteen for Europe. The Almaden mines yield from twenty-nine thousand to thirty-one thousand five hundred hundredweight; those of California, fourteen thousand hundredweight; Idria and Carniola in Austria, and other countries in Europe, produce five thousand nine hundred hundredweight, but the exportation of quicksilver from California increases rapidly, and threatens to become, at a future period, a monopoly.

The richest quicksilver mine yet discovered in CALIFORNIA is situated in the Santa Clara valley, about twelve miles from San José. It is worked by a company who hold possession under the old Mexican term of "denouncement." At this mine a large number of furnaces are in operation. These furnaces resemble in appearance a long steam boiler, set in brick, with fires underneath. The ore does not require to be crushed, except to a convenient size for the boilers. The mine is worked by Mexicans and Chilians, who carry the ore in raw hide sacks upon their shoulders, from the bottom of the mine to the surface, a height of from three to four hundred feet. This mine is one of the richest in the world yet known, and with the same facilities of machinery used elsewhere would yield a much greater amount than is now produced. California itself affords a good market for this ore, large quantities being used for separating fine particles of gold from the sand and dirt, and which cannot be effected by the ordinary process of washing.

In addition to this Californian quicksilver mine there are three or four others in the same valley, though not worked to the same extent, but these are said to be equally rich in yields of ore. It is said that the ancient inhabitants of this locality had known and resorted to these deposits of cinnabar for centuries for the purpose of procuring colouring materials, and it was by following their traces that a knowledge of the existence of this valuable mineral was obtained.

The quicksilver mines of GUANCAVELICA, in Peru, are upwards of a thousand feet in circumference, and of a prodigious depth. In this profound abyss are seen streets, squares, and a chapel, where religious mysteries on all festivals are celebrated. Thousands of flambeaux are continually burning in it. The miners suffer terribly from the mercurial vapours, which produce convulsions and paralysis. Thousands of workmen were condemned to forced labour in these frightful subterranean regions:—

> "Thus in the dark Peruvian mine confined,
> Lost to the cheerful commerce of mankind,
> The groaning captive wastes his life away,
> For ever exiled from the realms of day;
> While all forlorn and sad, he pines in vain
> For scenes he never shall possess again."

These mines were discovered about 1566, by Henry

Garces, a Portuguese, who was one day examining a red earth used by the Indians for making paint. He remembered that in Europe quicksilver was extracted from cinnabar, and with this earth he made some experiments which led to the opening of this extraordinary mine.

The quicksilver mines of IDRIA, a town in Hungary, have been worked constantly for upwards of three hundred years. They belong to the Austrian Government, and although the men are not paid high wages, yet their comfort is well looked after. They are six hundred in number, of whom two hundred are engaged at the works on the surface, where the mineral is extracted from the ore. A theatre has been erected for their amusement, and many means of relaxation provided. When any of the miners are ill, which is frequently the case, owing to the fumes of mercury which they inhale, they have the best medical advice; and when no longer able to work in the mines, the men are provided for by pensions, &c.

The discovery of this valuable mine was owing to some small quantities of quicksilver being found lodged in the hollows of a spring, by a merchant from Trieste. He conjectured that by excavating to a sufficient depth the source of the mercury deposits would be discovered. He obtained a grant of the ground from the Government, and began the works, which he continued for some years with success. It was, however, evident that a much greater depth would have to be attained, and to do this a larger capital than he was able to command was required. He therefore sold the works to the Austrian Government. They are now, next to the quicksilver mines of Almaden, the richest in Europe. The mine is worked in five levels. In some places the quicksilver is found in glistening globules, in a soft and partially decomposed state; but the greater portion occurs in the limestone itself, in which it is not visible, but the ore resembles very rich brown ironstone. The atmosphere of the mine is warm, with a close mineral smell; and in some of the rich places the miners are unable to work for more than two hours at a time, owing to the poisonous mercurial fumes. The total depth of the mine is eight hundred and forty feet. The works are situated about a mile from the town, but are not worked in summer, as the vapours are so poisonous that all vegetation and cattle in the neighbourhood would suffer. The mine is worked in the winter, when the fumes fall upon the surface of the snow, and are washed away when the thaw comes in the spring. The amount of quicksilver produced annually is about two hundred and fifty thousand pounds weight.

CHAPTER XX.

THE SALT MINES OF WIELICZKA AND HALLE.

ALL my young readers well know the value of that familiar and useful substance, SALT, which enters so largely into our daily wants, and is so essential to our existence. Formerly prisoners in Holland were kept from the use of salt; but this deprivation produced such terrible diseases that this practice was abolished. The Mexicans, in old times, in cases of rebellion, deprived entire provinces of this indispensable commodity, and thus left innocent and guilty alike to rot to death.

This mineral is frequently mentioned in the Bible.

The sacrifices of the Jews were all seasoned with salt, and we read of a *covenant* of salt. Salt was procured by the Hebrews from the hills of salt which lie about the southern extremity of the Dead Sea, and from the waters of that sea; which, overflowing the banks yearly, and being exhaled by the sun and heat, left behind a deposit of salt, both abundant and good. In ancient nations salt was a symbol of friendship and fidelity, as it is at present, among the Arabs and other Oriental people. In some Eastern countries, if a guest has tasted salt with his host, he is safe from all enemies, even although the person receiving the salt may have committed an injury against his entertainer himself.

Among the common people all over Scotland, a new house, or one which a new tenant was about to enter, was always sprinkled with salt by way of inducing "good luck." Another custom of a curious nature once prevailed in our own, and probably in other countries, in reference to salt. Men of rank formerly dined at the same table with their dependants and servants. The master of the house and his relations sat at the upper end, where the floor was a little raised. The persons of greatest consequence sat next, and all along down the sides, towards the bottom of the table, the servants were placed according to their situations. At a certain part of the table was placed a large salt vat, which divided the superior from the inferior classes. Sitting *above* the salt was the mark of a gentleman or man of good connections, while to sit *beneath* it showed an humble station in society.

Salt is found in greater or less quantities in almost every substance on earth, but the waters of the sea appear to have been its first great magazine. It is found there dissolved in certain proportions, two purposes being thus served,—namely, the preservation of that vast body of waters which, otherwise, from the innumerable objects of animal and vegetable life within it, would become an insupportable mass of corruption, and it is the means also of supplying a large proportion of the salt we require in our food, and for other purposes. The quantity of saline ingredients contained in the sea (according to the late Mr. Mudie) amounts to *four hundred thousand billions* cubic feet, which, if piled up, would form a mass one hundred and forty miles long, as many broad, and as many high, or otherwise disposed, it would cover the whole of Europe, island, seas, and all, to the height of the summit of Mont Blanc, which is about sixteen thousand feet in height. If salt, however, were only to be obtained from the sea, the people who live on immense continents would have a great difficulty in supplying themselves with it; and here you see how kindly Providence watches over the comfort of human creatures, for nature has provided that the sea, on leaving those continents, all of which were once overspread with it, should deposit vast quantities of salt, sufficient to provide for the necessities of the inhabitants of those parts. In some places the salt is exposed on the surface of the ground, in a glittering crust, several inches thick; in others thicker layers have been covered over with other substances, so that salt now requires to be dug for like coal or any other mineral. Salt is found in this last shape in every quarter, and almost in every country in the world. In this bountiful provision of nature you will see the wisdom and goodness of God, who has thus distributed alike to all His creatures one of the necessaries of life, the salt which gives a relish to our food, aids in its digestion, and enables us to preserve our nutriment against future wants.

At the present time, we may consider ourselves fortunate in possessing such abundant supplies of salt, and at such a moderate cost. In ancient times, and during the Middle Ages, the scarcity of salt, especially in inland countries, must have been injurious to the health of the people, and productive of many diseases, more especially as the use of vegetables containing salt was but little known. It is curious, too, that salt should at all times have been an object of monopoly, and subject to the most preposterous taxes, as it is still in some countries. Venice owed the commencement of her prosperity—indeed, her very existence—to the preparation of salt, which enabled her to supply almost the whole of Italy. In process of time the Venetians, not satisfied with this, seized the salt-works of their neighbours, and once forced a king of Hungary to shut up his salt mines. The sale of foreign salt by any subject of the Venetian republic was punished as a crime against the state, his house was razed, and he himself was condemned to perpetual banishment.

Salt mines are dry and healthy, and being supported by thick pillars of the same material at proper distances, they have a striking appearance when illuminated. *Rock salt* is of various colours—as red, blue, violet, brown, and even green; generally, however, of a dirty grey, though sometimes as white and beautiful as rock crystal. Salt crystallizes, and fine specimens are sometimes found adhering to the woodwork, in parts of the salt mines, where water has had access to the mineral. These crystals must, however, be kept in dry places, for damp would soon destroy their brilliancy. Chardin tells us that the rock salt of Kirman, in Asia, is so hard that the poor people make use of it for building their houses.

The art of making salt was known in very early times to the Gauls, the ancient inhabitants of France, and the Germans. The process was very simple, for Pliny informs us they did nothing more than throw the water on burning wood, when the former evaporated by the heat, and left the salt adhering to the ashes or charcoal. The ancient Britons were also acquainted with this art, and are said to have extracted the salt by the same method, for in the Cheshire salt springs pieces of half-burnt wood have been frequently dug up. The Romans made salt a source of revenue six hundred and forty years before the birth of Christ. Part of the pay of the Roman soldiers was made in salt, which was thus called *salarium*, from whence we derive the word "salary." The salt springs of Cheshire, and those of Droitwich, were well known to the Romans. Their mode of working them was similar to the process now employed.

Northwich, in Cheshire, is principally distinguished as the chief of the salt-towns. The salt rocks, about a mile from the town, were discovered in 1670 by English miners, who were looking for coal. The first bed of this mineral is found separated from a second and deeper one by a bed of hard and stony clay. These two saline masses, nearly free from earthy matter, have the astonishing thickness of ninety to one hundred feet. A very interesting account of a late visit to these mines has been published by one of the most talented Frenchmen of the day, M. Alphonse Esquiros, from whose work, the "English at Home," we extract the following description:—"I was led along a path by the side of a field, on which a black flock of rooks had settled, and beneath this field the mine extended. High chimneys and buildings of clumsy construction denoted the mouth of the pit; beneath a shed covered with tiles, and in which lay, pell-mell, enormous fragments of rock salt, was the shaft, on the edge of which I found a man who asked me if I wished to go down. On my affirmative reply, a large barrel, three or four feet in circumference, suspended in the air by a powerful chain, was lowered. I mounted the platform and jumped into the tub, which covered me nearly to the neck. As there were three of us, we were advised to keep close together, because the mouth of the pit was narrow and lined with iron to a certain depth, and we ran a risk of coming into rude contact with the sides of the shaft. The barrel, lifted by the chain, oscillated for a second over the pit's mouth, and then rapidly descended in the growing darkness. Already all was silent; nothing was to be heard save the filtering of the salt water through the rock, though the depth of the shaft was not more than three hundred and thirty feet, and the descent lasted only a few minutes; this journey seemed to me long and monotonous. It is natural enough, in such a case, to raise the eyes to the pit's mouth, in order to seek the light, the circle of which grew momentarily narrower. At about the middle of this shaft the light appeared like a moon; when the barrel reached the bottom it was only a star.

"We were received by a man of about fifty, with grey hair and a venerable face, who had worked in the mine since the age of twelve. He gave us long and thin candles; he had in his own hands a miner's candlestick; that is to say, a lump of soft clay, which allowed the light to be fixed against the sides of the rock. These lights only served to render the darkness more visible, which, at the first glance especially, seemed to cover the cavern like a black veil. The salt mines, however, have nothing of that solemn gloom which reigns in the entrance of coal mines, and you do not feel those drops of muddy water fall on your head which trickle through the damp and low roof. A salted but dry air, a pleasant and uniform temperature, penetrate these silent places, and the roof of the mine, supported by side walls or by pillars cut in the solid rock, is of considerable elevation. For the rest, the works and system of excavation are nearly the same as in collieries; man forces a way through the thickness of the solid and crystallized masses by the aid of pick and wedge or gunpowder. As you advance in the salt mine the scene widens, and the internal space is revealed to you; it is then difficult not to admire this simple but grand architecture, these empty spaces extending in the darkness like the nave of an immense subterranean church; these works which have the shape, colour, and transparency of sugar-candy; these massive pillars whose fronts shine in the reflection of the lights you carry in your hand; and more than all this, the religious character which silence and night shed over these labours of human industry. From time to time you see one or more lights flashing in the black extremity of the mine; they belong to the workmen. When they move, their lights vaguely design human forms, like those we fancy to ourselves inhabiting a wizard's cave. From time to time, too, the habitual silence of these vaults is violently disturbed by explosions that sound like thunder: it is the powder dislocating the limbs of the rock. You walk over a pile of ruins; the uneven floor is covered with gigantic fragments of crystal, which have principally a reddish or yellow colour, though some are white and transparent as glass. At the sight of these rent rocks, this mineral wealth, which seems to grow again beneath the strokes of the pick, or the train of gunpowder—for the mass is inexhaustible—you cannot but believe in a wise Providence of nature. Man likes to imagine that for him, and in view of his wants, these enormous magazines of salt were swallowed in the earth, these works of departed seas which laboured for him, and built these rocks at an infinitely remote period.

"The salt miners have their festivals. At Christmas and Whitsuntide as many as six hundred candles are lighted, and I leave my readers to guess the effect thus produced in the subterranean crystal palace by the reflection of these lights on so many glistening surfaces. Bands of music play suitable airs, and dancing sometimes goes on, the wives of the miners, on those days, being substituted for the somewhat coarse divinities with whom the ancients loved to people these deep grottoes. During the rest of the year, however, the salt mines have that serious character best suited to labour and night. My guide knew this vault as well as his bedroom, but I fancied that every pillar must be the last, for the rays of the candle I carried in my hand did not extend beyond that, but it was followed by another, then another, and between these two points appeared wide vaults, seemingly suspended over an abyss. At intervals the eye lost itself in an endless obscurity. At length we reached the end of the mine : a party of workmen were engaged here in extracting blocks of salt, which were piled up nearly to the roof. Among these workmen, some were performing a very hard task ; with their heads bowed down under the arch, they were digging out large pieces of crystal in the thickness of the wall, or forming the channel, which, when filled with gunpowder, would blow up the masses of rock. The number of workmen and mode of transport vary according to the importance of the mine. In the one I was visiting, fifty men extract weekly fifteen hundred tons of raw salt, and received daily wages of three shillings and sixpence; and the men themselves remove the rock. In other mines, horses, ponies, and donkeys are employed to drag the blocks of salt on a tramway. These animals were taken down the mine when very young, and only leave it to be killed: during the hours of rest they lie in a stable cut out of the rock salt. We returned to the entrance of the mine by a different road from that by which we reached the end. Though the time spent in these underground passages is not very long, and in spite of the interest created by the great features of human industry, the spirits are saddened by the darkness as by a cloak of lead. My guide, however, felt nothing of the sort, for he was attached to the mine as to an old acquaintance. He was proud of the admiration expressed on all faces by the sight of this rough crystal edifice, which seemed built by fairies in the interior of the earth. 'The only misfortune is,' he told me, 'that the salt mines cost a deal to work, and their duration is uncertain. They may be destroyed by divers accidents, but chiefly by the springs that run over the roof, and continually wear it away. At times these springs force their way into the works, dissolve the pillars on which the various parts of the mine rest, and produce the downfall of the whole mass, which leaves large craters on the surface of the soil as if after an earthquake. The miners, then, who may be at work are lost. Of course you saw, close by, the spot where a salt mine fell in a few years back, bearing in with it a steam engine, six horses, and nine men, and several houses.' The idea that the water ran over our heads, and that the roof of the mine might burst, had nothing very reassuring about it; but this imaginary danger added the charm of emotion to the gloomy beauty of the scene. By this time we had reached, through a vast gallery, the ventilating shaft, which English engineers compare with the trachean artery, for the miners breathe through it. Through the circles of gloom which rose whirling to the sky, the light of day could be seen, of the shape and whiteness of a shilling. Our guide made us presents—a few curious pieces of rock salt,—and then bade us good day. The tub which had conveyed us to the bottom of the mine drew us up again silently; in our ascent we saw the candles and the men gradually disappear, and after traversing the night we found ourselves again in the shed, in the midst of the blocks landed by the barrel."

The rock salt found in England is soon converted into an article of trade, on account of its susceptibility to damp. From the mouth of the mine it is first conveyed to the boiling-house, where it is purified and becomes as white as snow. These boiling-houses are clumsy-looking buildings, with a furnace and tall chimneys, which in the night flare in the skies like torches; you ascend by a wooden ladder to a platform, in the centre of which steams a caldron, open, but of slight depth, about twenty feet long by twelve feet wide. Into this the salt is thrown, and after boiling for six or eight hours, it is collected in barrows, which are nearly the shape of a sugar-loaf, and conveyed to a hot-room where it is left to dry for some days, and is then fit for use. The largest rock salt pit in England is at Witton, in Cheshire. This mine has been excavated in a circular form, one hundred and twenty yards in diameter. The roof is supported by twenty-five colossal pillars of salt. When lighted up this mine has a singularly interesting appearance.

Spain is the country where salt is found, most generally in masses above the ground. At Montserrat is a hill of salt, five hundred feet in height, and sixteen thousand feet around. The salt district of *Cordona*, in Catalonia, comprehends the hill on which the town is situated, and the environs of more than a league in circumference. The surface is almost everywhere covered with vegetable soil to the depth of six inches or more, which renders it productive. The place where the rock salt is procured is a valley, forming an oval about one mile and a half in length, and half a mile in breadth from east to west, extending from the Castle of Cordona to the promontory of red salt at the other end. The last is the most considerable of the salt rocks, and is six hundred and sixty-three feet high. This valley is also traversed by a chain of hills of rock salt; besides these there are other rocks of salt at the feet of the fortress. The mountain of red salt is so called because that colour predominates, but the colours vary with the altitude of the sun, and the greater or less quantity of rain. All the salt mountains are intersected by crevices and chasms, and have also spacious grottoes, where are found salt crystals shaped like bunches of grapes, and of various colours. Nothing can compare with the magnificence of the spectacle which the mountain of Cordona exhibits at sunrise. Besides the beautiful forms which it presents, it appears to rise above the river like a mountain of precious gems, displaying the various colours of the rainbow.

In Peru there are salt mines in mountainous situations, no less than *ten thousand feet* above the present level of the sea. The island of Ormus in the Persian Gulf is said to be one large mass of rock salt.

At Lahore, in India, there is an immense mountain of salt. On both sides of the Atlas mountains, in the north of Africa, there are plains covered thickly with salt, several miles in width, and extending as far as the eye can reach. In Abyssinia there is a plain of salt which occupies four days in crossing. In North America are immense fields of salt several inches thick.

Hungary and Poland afford the most numerous and extensive repositories of rock salt in Europe. The salt mines of WIELICZKA, near Cracovia, in the latter country, are the most curious of that character in the world. Stevens, in his "Travels through Hungary and Poland," &c., thus describes a visit that he made to it:—"I arrived at the town of Wieliczka, containing about three thousand inhabitants, and standing as it were upon the roofs of the immense subterranean excavations. The houses are built of wood, and the first thing that struck me was the almost entire absence of men in the streets, the whole male population being employed in the mines, were then at work below. I rode to the office of the superintendent, and presented my letter of introduction, and was received with great civility of manner, but his *Polish* was perfectly unintelligible. A smutty-faced operative accosted me in Latin, and I exchanged a few shots with him, but hauled off on the appearance of a man whom the superintendent had sent for to act as my guide,—an old soldier who had served in the campaigns of Napoleon, and, as he said, had become an amateur and proficient in fighting and French. He was dressed in miner's costume, fanciful and embroidered in gold, holding in his hand a steel axe; and having arrayed me in a long white frock, conducted me to a wooden building covering the shaft which forms the principal entrance to the mine. This shaft is ten feet square, and descends perpendicularly more than two hundred feet into the bowels of the earth. We arranged ourselves in canvas seats, and several of the miners who were waiting to descend attached themselves to seats at the end of the ropes, with lamps in their hands, about eight or ten feet below us. When my feet left the brink of the shaft, I felt for a moment as if suspended over the portal of a bottomless pit; and as my head descended below the surface, the rope winding and tapering to a thread, seemed letting me down to the realms of Pluto. But in a few moments we touched the bottom. From within a short distance from the surface the shaft is cut through a solid rock of salt, and from the bottom, passages almost innumerable are cut in every direction through the same bed. We were furnished with guides, who went before us bearing torches, and I followed through the whole labyrinth of passages, forming the largest excavations in Europe, peopled with upwards of two thousand souls, and giving a complete idea of a subterranean world. These mines are known to have been worked upwards of six hundred years. The tradition is that a nun of St. Casimir, having lost a gold ring, prayed to St. Anthony, the patron saint of Cracow, and was advised in a dream, that by digging in such a place she would find a treasure far greater than that she had lost, and within the place indicated these mines were discovered.

"There are four different ranges or stories of apartments: the whole length of the excavations is more than *six thousand feet*, or three quarters of an hour's walk, and the greatest breadth more than two thousand feet, and there are so many turnings and windings that my guide told me—though I hardly think it possible—that the whole length of all the passages cut through this bed of salt amounts to more than *three hundred miles*. Many of the chambers are of immense size. Some are supported by timbers, others by immense pillars of salt; several are without any support in the middle, and of vast dimensions, perhaps eighty feet high, and so long and broad as almost to appear a boundless subterraneous cavern. In one of the largest is a lake covering nearly the whole area. When the King of Saxony visited this place in 1810, after taking possession of his moiety of the mines as Duke of Warsaw, this portion of them was brilliantly illuminated, and a band of music floating on the lake made the roof echo with patriotic airs. We crossed the lake in a flat boat by a rope, the dim light of torches and the hollow sound of our voices giving a lively idea of a passage across the Styx. From this we entered an immense cavern, in which several hundred men were working with pickaxes and hatchets, cutting out large blocks of salt, and trimming them to suit the size of barrels. My guide called up a party who disengaged with their pickaxes a large block of salt from its native bed, and, in a few minutes, cut and trimmed it to fit the barrels in which they are packed. All doubts of their being creatures of the upper world were removed by the eagerness with which they accepted the money I gave them. There are more than a thousand chambers and halls, most of which have been abandoned and shut up. In one is a fanciful collection of things, such as rings, books, crosses, &c., cut in the rock salt.

"Most of the principal chambers had some name printed over them, as the 'Archduke,' 'Carolina,' &c. Whenever it was necessary my guides went ahead, and stationed themselves in some conspicuous place, lighting up the dark caverns with the blaze of their torches, and after allowing me a sufficient time struck their flambeaux against the wall, and millions of sparks flashed and floated around the chamber. In one place, at the end of a long dark passage, a door was thrown open, and I was ushered suddenly into a spacious ball-room, lighted with torches; and directly in front, at the head of the room, was a transparency with coloured lights, in the centre of which were the words '*Excelso hospiti*,'—'To the illustrious guest,' which I took to myself, though I believe the greeting was intended for the same royal person for whom the lake chamber was illuminated. Lights were ingeniously arranged about the room, and at the foot, about twenty feet above my head, was a large orchestra. On the occasion referred to a splendid ball was given in this room. The roof echoed with the sound of music, and it is said that the rich dresses of a numerous company, and the blaze of light from the chandeliers reflected upon the surface of the rock salt, produced an effect of inconceivable brilliancy. Perhaps the most interesting portion of the mine is the chapel dedicated to St. Anthony, which is said to be more than four hundred years old. The columns with their ornamental capitals, the arches, the images of the Saviour, the Virgin and saints, the altar and the pulpit with all their decorations, and the figures of two priests represented at prayers, are all carved out of the rock salt. Following my guide through all the different passages and chambers, and constantly meeting miners and seeing squads of men at work, I descended by regular stairs cut in the salt—but in some places worn away, and replaced by wood or stone—to the lowest gallery, which is nearly a thousand feet below the surface of the earth. I never felt man's feebleness more than here; for all these immense excavations, the work of more than six hundred years, were but as the work of ants by the road-side. The whole of the immense mass above me, and around and below to an unknown extent, was salt, a wonderful phenomenon in the natural history of the globe. It has been thought that this spot was formerly covered by the sea, and that the salt is a gradual deposit formed by the evaporation of its waters. I was disappointed in some of the particulars which had fastened themselves upon my imagination. I had heard and read glowing accounts of the brilliancy and luminous splendour of the passages and chambers, compared by some to the lustre of precious stones; but the salt is of a dark grey colour, almost black; and although sometimes glittering when the light was thrown upon it, I do not believe that it could ever be lighted up to shine with any extraordinary or dazzling brightness. It was late in the afternoon when I was hoisted up the shaft. These mines are, indeed, a wonderful spectacle, and I am satisfied that no traveller ever visited them without recurring to it as a day of extraordinary interest."

Another description of a salt mine will interest you. It is from the pen of a well-known traveller, Inglis, who has given a vivid picture of the scenes he visited. The situation of this mine is at HALLE, or Hallein, a town of Austria, in the duchy of Salzburg, noted for its extensive salt-works and saline baths. The Durrenberg, a mountain two thousand three hundred and eighty-eight feet above the level of the sea, from which the brine is obtained, has thirty-four shafts or rooms, from which the salt is conveyed in large wooden troughs to the works within the town.

We will now follow Mr. Inglis in his tour of inspection. "Almost immediately after reaching Halle I presented myself at the gate of the salt manufactory, and was soon admitted upon showing a permission from the superintendent. The building is of immense extent, and here the manufactory has been carried on since the commencement of the fourteenth century. The native salt, at twelve miles distance, after being dissolved in water at the mines, is conveyed to Halle in little rivulets, which flow in troughs laid for the purpose, there to be converted into crystals. Nine caldrons are employed, the five largest of them about thirty-six feet in diameter. They are made of iron, and have an opening at one side by a joint, in order that they may be cleaned from salt when necessary. The salt water being previously heated is admitted into the caldrons to the depth of eight inches, and is kept in a boiling state about three hours, at the end of which time two inches and a half have been evaporated, and a great quantity of salt deposited. The annual amount is reckoned at about four hundred thousand hundredweight.

"It is scarcely possible to conceive a more horrible abode than Halle; it is constantly enveloped in a dense atmosphere of smoke, which not only darkens the air and blackens the houses, but throws a dinginess over the dresses of the people, and makes the inhabitants appear of a sootier and duskier race. At daybreak next morning I left the town to visit the mines. In less than half an hour I found myself at the foot of the chain of mountains that bound the valley to the north, and at the mouth of a narrow ravine, traversed by a furious torrent. A path leads up the ravine towards the mines, which lie about eight miles farther, in the heart of the mountain. I have seldom ascended a steeper path than this, or one more interesting from the sublimity of the scenery that lay around. The grandeur of the views and ruggedness of the objects in traversing a gorge that penetrates so many miles into the recesses of the mountains may be imagined; and perhaps it is better to leave all to the imagination than attempt a description. Enormous masses of overhanging rocks seemed to be suspended above, almost by a miracle; old pine forests hung upon the rugged cliffs; the torrent that rushed by was here and there spanned by bridges of snow, while huge melted avalanches lay in its bed; cascades tumbled from a hundred heights—some close by the path, some at a great elevation above,—while peaks, some dark, some snowy, many thousand feet high, almost closed overhead, and seemed to jut into the sky. At length, in the midst of this wild scene, a cluster of houses are seen above, where the gorge lost itself among precipices, and where the torrent has separated itself into a hundred tiny feeders, oozing from the beds of snow. At this wild spot stands the miners' inn, and here, therefore, I began to think of satisfying the wants of the body. The superintendent of the mines, however, chanced to be close by, and presenting to him the letter I brought, he politely invited me to his house, which lies upon a small platform a little higher up, and soon produced a comfortable breakfast, and insisted that I should dine with him also, and spend the night in his house.

"After breakfast I proceeded to the mines, clothed in a suitable dress and with a staff in my hand, and preceded by torches, I followed my conductor into the mine. The visit commences with a descent of three hundred steps, when one may fairly believe himself to be in the bowels of the mountain. It is a strange empire one finds in these dismal abodes. Life is a different thing when sunlight is withdrawn; and an icy feeling falls upon the heart, as well as on the senses, when we look around these dismal galleries and dark walls, dimly lighted by a few torches that convey truly the idea of 'darkness visible,' and scan the dark subterranean lakes, whose extent and depth the eye cannot guess, except by the plunge of a fragment of the roof, and the dim glimmer of the lights, and hear the distant strokes of the miner's axe far in the interior of the caverns; and still more do we feel the difference between the world above and regions such as these when we reach the solitary miner in some vast cavern, with his single candle, striking his axe ever and ever into the dull wall: but along with these feelings, astonishment and admiration are engendered at the power of man, whose perseverance has hollowed out the mountain, and with seemingly feeble instruments—his hammer, arms, and little axe—has waged war with the colossal works of nature.

"The results are, indeed, almost incredible. No fewer than forty-eight caverns have been formed, each *from one to two acres in size.* One of the galleries is nearly nine miles in length; and I was assured that to go through all the galleries *six* whole days would be required. The manner of proceeding is thus: when these subterraneous caverns are formed, the miners detach fragments of the native salt from the roofs and walls; and when the cavern is sufficiently filled with these, pure water is let in, which dissolves the salt. When I visited the mine some of these caverns were dry, and the miners were employed in them; others were salt lakes, in which the more silent operation was going on. Occasionally a distant, hollow sound is heard approaching nearer and nearer, which one easily mistakes for the rushing of water; this is occasioned by the little chariots which carry away rubbish to the mouth of the mine: the path is a railroad, and these little chariots fly upon it with frightful rapidity. When the sound is heard approaching, it is necessary to retire into one of the niches that are formed in the wall; and the young miners, seated in front of their chariots, seem, as they pass by, like gnomes directing their cars.

"The miners work and rest alternately four hours. Before leaving the house where I had put on my dress, they showed that which had been worn by the Emperor when he visited the mines; it is of satin, trimmed with gold lace, and very fit for an emperor."

Natural brine is obtained at Droitwich and Stoke, in Worcestershire, and Nantwich in Cheshire. At Droitwich the shaft is only sunk to a depth of one hundred and seventy-five feet, and the brine rises to the surface and overflows if not pumped. There are, however, reservoirs made for it, into which it is pumped, and from which it is distributed to the various works, which are little more than large sheds, with numerous openings in their roofs to allow the steam free egress. Pipes run from end to end of the floors, and on these rest the iron evaporating pans, which are about sixty-five feet long and twenty-five feet broad, and about eighteen inches in depth. In other places very deep shafts have been sunk, and the brine requires to be pumped from a great depth. The pipes heat the brine to nearly boiling-point, and as a large surface is exposed, the evaporation is very rapid, and the crystals are small, as in the fine table salt. If, however, the heat is more gentle, the salt is coarser, and is fit for curing meat, fish, &c.; and when very slow, a much coarser kind, called *bay salt*, is produced.

The salt ways at Droitwich are of great antiquity, as they appear to have been known to the ancient Britons, and from numerous discoveries of Roman remains at the works, there is every reason to suppose that they were in great requisition in those days. The Anglo-Saxon kings possessed a right to levy certain dues at the pit's mouth, upon the waggons as they stood, and the loads placed in them.

Besides the rock salt found in Cheshire, there are numerous *brine springs* in that county, from which a large amount of salt is obtained. Brine springs rise in the coal-mines near Ashby-de-la-Zouch, in Leicestershire, at the depth of two hundred and twenty-five yards from the surface. There are numerous brine springs in North America, in France, Spain, &c.

Of the various ways of obtaining salt for domestic purposes, the earliest and most simple, perhaps, is that by which the heat of the sun is caused to assist in the process. It is practised to a great extent in France, Spain, and Portugal, where large quantities of excellent salt are produced in this manner, in large ponds called *salt gardens*, which are cultivated from March to the end of September. These gardens are simply a number of shallow ponds, laid out on a stiff clay soil on the coast, and protected from the action of the tides. The principle upon which they are constructed is, to expose the largest possible surface to the action of the sun. The first pond, which is usually about five feet deep, has a sluice, by means of which it can be filled from the sea. Here the water is allowed to deposit its mud and become clear. From this pond it passes, by means of a pipe, into a second pool, much smaller and shallower, and divided into compartments by narrow dykes, so arranged as to cause the brine from the settling pond, entering at one corner, to describe a circuitous course through every part of the pond before it escapes at the opposite corner into the third pond, which is still shallower than the second, but is subdivided like it. From the third pool it passes into the fourth, where it begins to crystallize. The salt, as fast as it forms, is collected with rakes into small heaps on the narrow banks which separate the ponds. The briny liquor, after the first crop of salt, is run into another series of smaller and shallower ponds, where a second and third crystallization of salt takes place, but of an inferior quality to the first. When no more salt separates, the remaining liquor is run into the sea. The salt, as it is at first raked out of the ponds and made into heaps, is very impure, the principal foreign substances being chloride of magnesium, which is a compound similar to salt, the soda of the salt being replaced by magnesia. This substance imbibes water from the atmosphere and becomes liquid. It is this impurity which causes salt to become damp in winter. To get rid of this and other foreign matters, the salt, after draining, is piled into great heaps and thatched with dry grass, and is thus protected from the rain; but the moisture of the atmosphere gradually liquifies the chloride of magnesia, which, in draining away, washes the greater part of the other impurities away with it.

A story is told of a clockmaker at Malta, who was ambitious to make a fortune by constructing some salt-works, which proved, however, disastrous not only to himself, but to his neighbours. The small island of Goza is situated about four miles to the east of Malta, of which it is a dependency. There is a curious terrace at that place, to the west of the hill Zebug, and at the lowest part of a valley leading to the sea. The entrance to it by land is through a long range of rocks, greatly declining towards the shore, but stopping abruptly just above it, where the rocks become perpendicular cliffs, standing thirty or forty feet above the level of the water. The clockmaker, who was the proprietor of this esplanade, thought he could derive advantage from what was wholly unprofitable, by converting it into a salt pan, where salt might be obtained from sea water by evaporation. The intense summer heat which was concentrated there by the surrounding rocks and hills promised a rapid process, and he went to work in the hopes of making the barren spot into a source of immense wealth, but without any notion of the strange results which actually occurred. He dug a reservoir, and built a wall along the edge of the precipice to retain the sea water, which it was necessary to spread over a wide surface. This done, he devised means to raise the water—for to draw it up at the edge of the cliffs was found to be a great waste of labour. After sundry experiments and examinations, he at last discovered that there was a cave or grotto running under the rocky esplanade, which communicated with the sea, and admitted the water to the very point where he wanted it, though it was still some thirty or forty feet beneath the level of his pans. He therefore cut through the rock that formed the vault or roof of the grotto, and thus made a sort of well through which the sea water was drawn up. Having spread the briny fluid over a wide surface, he was delighted to find that it diminished in depth with great rapidity, which he attributed solely to evaporation, and the natural effects of the sun's rays. In order to increase his harvest he kept pouring on more and more sea water, and this he did until he was thoroughly convinced he should have a thick layer of pure salt. But alas! the water, instead of being evaporated, and leaving its solid brine behind, was absorbed by the spongy rock, through which, by filtration, it soon returned to the places from which it had originally been brought, or to the marine grotto and sea beneath, and when the poor clockmaker went to gather his harvest he found nothing but a coating of mud, the acid of the salt water having partially dissolved the superficies of the rock on which it had been retained. This was a cruel disappointment, but the enterprising clockmaker should have remembered the old proverb, and have "looked before he leaped." The slightest elementary knowledge of chemistry and geology would have preserved him from this error, which, indeed, he might have avoided, without any science at all, by making one or two experiments on the rocks, or even by simply observing the natural processes constantly in operation, which would have plainly shown to him that the soft rocks of Malta and Goza are not only excessively porous, but liable to rapid decomposition under sea water.

The clockmaker fell sick of grief and disappointment, and had a long and dangerous illness. But his misfortunes, and the evil effects of his want of foresight, did not end here. As winter approached, the weather, as usual, became windy and the sea rough. "One day in particular," says Mr. Boisgelin, the historian of Malta, "a terrible storm arose, and the violence of the wind drove the raging waves into the grotto under the salt works, where the body of water increasing considerably, and being confined in this almost circular cave, acted with a rotatory motion and became a siphon, or water-spout. There being no passage but the well newly opened by the clockmaker, it there forced its way through with violence, and appeared above, like a beautiful wheatsheaf, of so large a circumference as to fill up the whole mouth of the well, and rising perfectly entire to the height of sixty feet, formed a magnificent sight. Its projectile force was so great that the wind could not act upon it until it had reached the above-mentioned height, when it suddenly separated, and the waters composing this immense body were diffused over the country on all sides to the extent of more than a mile. This violent rain of salt water destroyed all vegetation, and the cultivated fields, which before had been amply productive, appeared as if they had suffered from fire." Those whose property had been thus devastated were loud in their reproaches to the poor clockmaker, and not satisfied with this, they brought an action against the unfortunate projector, and claimed heavy damages. The clockmaker died before the affair was settled, but the mischievous results of his engineering survived him. To prevent further calamities, the people of Goza, whose property was exposed, stopped up the mouth of the well with large stones—an operation which occasioned another phenomenon as extraordinary as the first. "A great quantity of air," says Boisgelin, "was confined by the waves in the bottom of this grotto; which, being rarified, repulsed the water with such violence as to cause the most terrible explosions, which not only shook the rock, but the whole of the neighbourhood. The tremendous noise of these different explosions resounded through all the grottoes (which are more or less connected with each other on the coasts of Malta and Goza), and resembled a discharge of artillery of all sizes quickly succeeding each other. These sounds being constantly echoed had the effect of the most violent peals of thunder, particularly when different storms met together. Terror became general, and constant apprehensions were entertained that the rocks would be thrown down, under which this subterranean thunder never ceased to roar when the wind was high. This horrible noise still continues whenever the well is filled up with stones, but when the impetuous waves confined in the cavern have, in some degree, removed the stones at the bottom of the well, the water acts with the greatest violence upon them, breaking them, reducing them to powder, and driving them back into the sea. The first stones being carried away, the others fall of course; and the well once cleared, the wheatsheaf of water forms again, and spreads desolation through the adjacent country."

In the course of a few years this destructive waterspout occurred several times; and every time it was seen, or the water was heard roaring and threatening in the cavern beneath, the peasants exclaimed with sorrow and spite, "*There's that unlucky clockmaker again!*"

In countries where the sun does not offer much assistance, and no mines or salt springs are at hand, the *boiling of sea water* in works upon the coast are resorted to. This process, as pursued in Scotland, may be thus described:—a reservoir is built near the sea, into which, at high water, supplies are taken in by means of a pipe extending a good way down the beach; for it is an object to get the water from a point as far below the surface as possible, so that it may be more impregnated with salt, and require the less consumption of fuel. From this reservoir the water is pumped into the neighbouring pans, which generally extend in a range on both sides. The pans are shallow vessels of plate-iron, about twenty feet in length and twelve feet wide, having a furnace below, with a space for holding coal. The whole apparatus is contained in a small cot, the covering of which is of wood, fastened by pins of the same material, as iron nails are liable to rust. A space is left in the roof to permit the vapour of the salt to escape. Two men attend on each pan. The salt is at first very light and floury in proportion to its weight, and in this state it is most appreciated.

Nearly all the salt consumed in Ireland is obtained by evaporation; and in many places, especially in Cork, the process is effected by the waste heat from the operation of lime-burning, the salt, in evaporating pans, being placed over kilns which are in constant action.

Besides the sea there are *salt lakes*, though comparatively few in number. One of the most famous natural curiosities in America is the SALT LAKE OF UTAH, originally a part of the territory of Upper California, ceded to the United States by Mexico in 1848. This great salt lake is about seventy miles long and thirty-five miles wide. It is so salt that no living thing is found in it, and on the receding of the waters from the beach in the dry season, it is left covered with thick masses of salt. No person, without witnessing it, can form an idea of the buoyant properties of the water. A man may float, stretched at full length on his back, having his head and neck, both his legs to the knee, and both arms to the elbow, entirely out of the water. If a sitting position be assumed, with the arms extended, the shoulders will remain above the surface. The water is, however, extremely difficult to swim in, on account of the constant tendency of the lower part of the body to rise above it. The brine, too, is so strong, that the least particle of it getting into the eyes produces the most acute pain, and if accidentally swallowed, rapid strangulation must follow. "Upon one occasion," says Lieutenant Stansbury, "a man of our party fell overboard into the lake, and, although a good swimmer, the sudden immersion caused him to take in a few mouthfuls of water before rising to the surface. He had a violent paroxysm of strangling and vomiting, and was unfit for duty for two days afterwards. In the latter portion of the first desert (bordering on the lake) we crossed a field of solid salt, which lay encrusted upon the level mud plain so thick that it bore up the mules loaded with their packs so perfectly that they walked upon it as if it had been a sheet of solid ice slightly covered with snow. This field was ten miles in length and seven in width, and the thickness of the salt was from one-half to three quarters of an inch. The salt in the solid field was perfectly crystallized, and where it had not become mixed with the soil it was as white and fine as the best specimens of table salt."

You may form an idea of the immense quantity of salt that is consumed in this country, or exported to different parts of Europe and America, when I inform you that the yearly production of salt in England exceeds five hundred thousand tons, giving employment to upwards of ten thousand workmen.

Before we close this chapter on salt I would remind you of the invaluable blessing this gift of Providence is to mankind. I cannot enter into all the innumerable uses to which salt is applied besides its necessity to our own personal health and comfort. By the aid of salted meats our sailors and travellers are able to take long voyages, for without them delays would occur in obtaining fresh provisions, and all enterprise would be impeded. The cheapness and abundance of this condiment have enabled England to carry on her fisheries with great success and advantage. Agriculture is largely indebted to salt for the nutriment it supplies to the earth. Many chemical productions and medicinal drugs require the use of salts. Salt is employed, on a great scale, in fattening cattle. It is calculated that *one million tons of salt are annually given to the cattle and sheep of Great Britain.* It assists in the manufacture of glass, the varnishing of earthenware, bleaching of linen, tempering of steel, and renders iron malleable. How thankful should we be for all these blessings!

"When gratitude o'erflows the swelling heart,
And breathes in free and uncorrupted praise
For benefits received, propitious Heaven
Takes such acknowledgment as fragrant incense,
And doubles all its blessings."

CHAPTER XXI.

EMINENT MEN WHO HAVE BEEN CONNECTED WITH MINING.

I WILL now tell you about some famous men who were once miners, and raised themselves in the world by their perseverance and talents. You have heard of MARTIN LUTHER, the greatest of the Protestant Reformers in the sixteenth century, who disputed the power of the Pope, and brought about a wonderful change in the religious opinions of the times. This extraordinary man was born in 1483, in Saxony, a country which has always been remarkable for the rich mines it has produced. His father was a miner in humble circumstances, a good and worthy man, but strict in the management of his children, and very anxious to improve their condition. His mother was an excellent woman, and the example of both parents no doubt greatly influenced the character of Luther in after life. He tells us that his father sometimes whipped him for a mere trifle until the blood came, but he also tenderly cared for him, and was in the habit of carrying him to and from school in his arms with affectionate solicitude. To pay for this schooling the father had to save from his hard earnings, but the son made great progress, though his training was hard and severe, for he informs us that the schoolmaster used the rod upon him fifteen times in one day. He was afterwards sent to a school at Eisenach, and in order to support himself there was obliged to sing through the streets and beg for a livelihood. Fancy this, my young readers, and thank God and your parents that you are not obliged to undergo such hardships in getting an education. At length a good lady, of the name of Cotta, took notice of the poor student, and gave him a comfortable home while he was at the school.

When Luther had reached his eighteenth year he was sent to the university of Erfurt, where he was supported by his father, and three years afterwards he returned home, and for two years is supposed to have worked in the mines to obtain the means for continuing his studies. When old John Luther died he left his son Martin a house, two iron furnaces, and about one hundred and fifty pounds; but better than all this, he left a reputation for honesty, industry, and other virtues, which, after all, is the best legacy that a father can leave to his children, if they follow such an example.

Many were the hardships endured by Luther through the greater part of his wonderful career; but he was supported through all by Providence, the protector of those who think and act worthily for themselves. When you read the life of this great man, you will find that he never forgot the lessons he had received in his youth, and this strengthened him through perilous times, when his life was frequently in danger.

One of the most remarkable men in modern times was GEORGE STEPHENSON, whom we have already mentioned as the inventor of a safety-lamp for the security of miners against fire-damps. He was born in 1780, in a small cottage a few miles from Newcastle-on-Tyne. His father is said to have worked in a coal mine, or colliery, and was much respected by his employers for his upright character. Having several children he was too poor to give his son George an education, and, at an early age, when most boys are scarcely out of the nursery, the lad was placed out to work, leading a horse at the plough, when he was so small that he could scarcely stride the furrow, riding the animal to the field early in the morning, when most children are fast asleep. For this work, or in picking rubbish from the coal heaps, he earned twopence a day, which helped to pay for his share of the household food. We are told that when he worked at the colliery he was so young-looking that he often had to hide himself when the overseer of the mine came round, for fear he should be thought too little to earn his small living. From twopence his wages were advanced to fourpence, and at length to sixpence a day.

When Stephenson became a young man, he showed a great talent for mechanical pursuits, and is said to have mended the clocks and watches of the miners who worked in the coal pits, and thus he increased his earnings. These were small, but he contrived not only to support himself, but to assist his father and mother. You may imagine how glad he was to do this, for although his parents were poor, they had taught their children to love God, and obey them, and to be careful and prudent. We next find him at the colliery at Killingworth, where he gained one shilling a day working as fireman at an engine in a coal-pit, used for raising the water. He tells us that he had then to work early and late, often rising at one or two o'clock in the morning. While in this humble employment, he applied himself to a diligent study of the steam-engine, frequently taking it to pieces when he could find time, and thus gaining a practical knowledge of its construction. You will see how useful to him this was in after years.

The early life of Stephenson shows what industry and cleverness can do against poverty. Out of his small gains he managed to pay fourpence weekly for lessons in reading, writing, and arithmetic, which he had only time for at night, and by the aid of his engine fire. His next promotion was to be an engine-man, at twelve shillings weekly. This was a great step in life, which he never forgot, for in after years when he had become rich and famous, being at Newcastle, he sent for an old fellow-workman to dine with him and talk over his youthful days. "Do you remember, George," asked his friend, after dinner, "when you had your wages raised?" "Well," said Stephenson, "what of that?" "You came out of the office all smiles, and told us you were a man for life. Now you would find it hard to tell how much you have a week." "Yes," answered Stephenson, "I dare say I should."

When Stephenson arrived at man's estate, he felt himself worthy of better work than he was engaged in, and he felt inclined to emigrate, but an event happened that changed his intention. He had to pass on his way to work every day a newly-sunk coal-pit, out of which the miners were endeavouring to draw the water, and he saw how difficult it was for them. He could not help saying that if they would let him, he would soon have the water out. He was at first laughed at, but the overlooker at last gave him permission to look at the mine, which he did, and explained clearly that for a hundred pounds the mine could be set to work, which was done. Stephenson was made an overlooker, with a horse for his use. He now thought of marriage; there was a farmer's daughter who lived near the place where he worked, and he proposed to her, but was refused. There was a servant in the same house, whom he sought, and was accepted. By this marriage he had a son, Robert Stephenson, who became a Member of Parliament, and was one of the most eminent engineers in the world.

George Stephenson now began to look out for a wider field of exertion. He seems to have been engaged in most branches of colliery work, and at this time he showed his engineering abilities by laying down some tramways, or waggon-ways, in the northern coal mines. The invention of the safety-lamp (to which we have before alluded) brought Stephenson into public notice, and from this period the tide of prosperity set in. It was at Killingworth colliery that he constructed his first locomotive steam-engine to run on rails. The invention of the locomotive engine belongs to Trevithick and Vivian, two natives of Cornwall, who made one in 1802 to run on common roads, but as Stephenson first applied steam power to locomotive engines on railways, he has been regarded as the father of English railways. In 1821 he was appointed engineer for the construction of the Stockton and Darlington railway; the line, on its completion, being partially worked by means of his great invention. The Liverpool and Manchester railway was commenced under his direction in 1826, for which he received a salary of one thousand pounds a year.

What a strange contrast to the former period of his career when he considered himself "a man for life," on receiving twelve shillings a week for his wages!

On the completion of this line in 1829, the directors of the railway offered a prize of five hundred pounds for the best locomotive engine that could be constructed, and this resulted in the triumph of Stephenson's "Rocket," which, to the astonishment of every one (except himself) was found capable of travelling at the rate (then considered marvellous) of thirty-five miles an hour.

The offers of work that flowed in upon the now famous engineer was numerous. His time and talents were in constant requisition. He has been known to dictate reports and letters for twelve continuous hours. In one year alone (1836), upwards of two hundred miles of railway were placed under his direction, involving a capital of five millions of money. Stephenson bought large estates and collieries in Derbyshire, and was the means of opening that coal-field to the world.

Here is a lesson that every youth can profit by, if he considers the ways and means by which George Stephenson raised himself from obscurity to greatness. It is true that instances of such wonderful natural abilities as he possessed, and which were developed by laborious application, are rare, but it is in the power of every one to improve his condition by keeping in view such an example. Hard work need not prevent us from enjoying ourselves at intervals, and more, perhaps, than if we devoted most of our time to pleasure. We are told of Stephenson that even amidst his immense business, his heart remained as youthful as ever. In spring he would snatch a day for bird-nesting or gardening; in autumn, nutting was a favourite recreation. We find him, at this time, writing a touching account to his son of a pair of robins.

This great and excellent man spent his declining years, occupied with the quiet pursuits of a country gentleman, indulging his love of nature, which through all his busy life had never left him. He died at Tapton, August 12th, 1848, at the age of sixty-seven. His monument stands at the Euston Square railway station, London.

George Stephenson's genius was inherited by his only son Robert, who was born in 1803, and died October

12th, 1859. This illustrious engineer, to whom we are chiefly indebted for the Britannia Tubular Bridge, one of the most remarkable monuments of modern skill, went through an immense amount of work both at home and abroad, which remain the monuments of his genius and perseverance. Robert Stephenson inherited the kindly spirit and benevolent disposition of his father, whose memory he almost worshipped, and was ever ready to attribute to him the chief merit of his own achievements. He became a Member of Parliament, and was decorated by the Emperor of the French, in 1855, with the order of the Legion of Honour. He had been offered knight hood by his own Sovereign, but refused the distinction, which, after all, could not have enhanced the real lustre of his great name.

Another man who raised himself from obscurity to a place amongst the most distinguished men of the age, was RICHARD TREVITHICK, a native of Cornwall, and who, I have already mentioned, was the inventor of the first locomotive engine worked by steam power to run upon roads. This ingenious man was, in early life, connected with mining, and may therefore be included in our list of eminent miners. He was born in 1771; his father was purser or paymaster of several mines, and could have given him the best education that the neighbourhood afforded, but the boy had no taste for school exercises, and was allowed to spend his time as he pleased; so he used to stroll over the mines amidst which he lived, observing the engines and machinery, and conversing with the miners and engineers, and any one who could give him any information. The lad had a natural genius for mechanics, and had also a good memory which served him well in after life. Without much aid, therefore, from books, and more from personal inquiries, and inspecting machinery, he obtained a practical knowledge of what was required for mining purposes, so that before he was twenty-one years of age, he was, to the utter astonishment of his father, appointed engineer to several mines.

You must remember that it is not all youths who have this disposition for acquiring knowledge implanted in them; many become great men by hard and plodding industry, and application to books, and thus attain the object of their desires; others have quicker intelligence, and get over many difficulties from a deficiency of book-learning by a deeper practical ability. Trevithick's father was afraid that his son was attempting too much, and begged the mine agents to reconsider what they had done, as he was sure that his son could not, at so early an age, be qualified for so responsible an office. The mine agents, who well knew the abilities of the son, were amused at the honest fears of the father, and on reaching manhood, young Trevithick found himself engaged in responsible employments, usually the lot of older and more experienced men. His inventive genius, however, soon displayed itself, and became known throughout Cornwall. Before he was of age, he had, with the assistance of William Bull (a workman who had been employed by the celebrated James Watt to erect his steam-engines in Cornwall), constructed several engines which did not come within the patent of Watt's, thus showing marvellous inventive genius. Trevithick at this time was remarkable for his strength; he stood more than six feet high, and could lift two blocks of tin placed one on the other, and weighing seven hundredweight. With such physical power he was, however, gentle, unassuming, and pleasing in his manners, and he had great facility in expressing himself with clearness on all subjects.

Within a period of thirty years this great man had invented and constructed a vast number of objects, many of them very important, as we are informed in the Catalogue of the South Kensington Museum, where he is described as the "inventor and constructor of the first high-pressure steam-engine and the first steam-carriage used in England; constructor of a tunnel beneath the Thames, which he completed to within a hundred feet of the proposed terminus, and was then compelled to abandon the undertaking; inventor and constructor of steam-engines and machinery for the mines of Peru capable of being transported in mountainous districts), by which he succeeded in restoring the Peruvian mines to prosperity, also coining machinery for the Peruvian mint, and of furnaces for purifying silver ore by fusion; the inventor of other improvements in steam-engines, impelling carriages, hydraulic engines, propelling and towing vessels, discharging and stowing ships' cargoes, floating docks, construction of vessels, iron buoys, steam boilers, cooking, obtaining fresh water, heating apartments," &c.

Trevithick had made a beautiful model of his steam-engine, patented in 1802, and exposed it for sale in a shop in London. It happened that at this time a Swiss gentleman, named Uvillé, who had come from Lima, the capital of Peru, where he had some rich silver mines, but could not work them for want of machinery to get out the water, saw this model, purchased it, and returning to Lima, tried it in the mines, and found it successful. A company was then formed to work the mines, and M. Uvillé returned to England and obtained nine steam-engines manufactured by Trevithick, with which he returned to Peru, followed soon after by Trevithick, who arrived there in 1816. The fame of the young engineer had preceded him, and he was received by the Viceroy of Peru and the inhabitants with acclamations. The Lima newspaper announced the arrival of "Don Ricardo Trevithick, an eminent professor of mechanics, machinery, and mineralogy, inventor and constructor of the engines of the last patent, who directed in England the execution of the machinery now in Pasco mines. This professor, with the assistance of the workmen with him, can construct as many engines as shall be wanted in Peru, without sending to England for any part of these vast machines." In a private letter Trevithick says, "The lord warden was sent from Pasco to offer me protection, and to welcome me to the mines. The Viceroy sent orders to the military at Pasco to attend to my call, and told me he would send whatever troops I wished to have with me. As soon as the news of our arrival had reached Pasco, the bells rang, and they were all alive, down to the lowest labouring miner. The lord warden has proposed erecting my statue in silver."

What the results of Trevithick were among the mines of Peru we are scarcely aware, for the wars which broke out among the Spanish colonies put a stop to all mining operations for a time. At length he returned to England in 1827, after having encountered hair-breadth escapes and extraordinary adventures. This eminent man died at Dartford, in Kent, in 1833.

We have mentioned Trevithick's attempt to bore a tunnel under the Thames. This happened many years before the present tunnel was constructed by the celebrated Mr. Brunel. Trevithick commenced his operations by driving a small level, as in a mine, to test the character of the ground. It is said he succeeded in getting through about one thousand feet, and took the directors of the company to see the work. One director refused to believe his statements, and Trevithick, who, although a highly-gifted man, was passionate, in a fit of rage thrust a bar up into the top of the level, and being then under the bed of the river, the result of the experiment was, the party had great difficulty in making their escape. This was certainly unwise, and might have been attended with very serious consequences, and in his cooler moments no one would have regretted a want of temper more than Trevithick, who had, naturally, a noble and generous spirit.

You will understand the value of Trevithick's inventions, when by his improvements in the steam-engines alone, used in his native county, he effected a saving in working the mines of one hundred thousand pounds yearly, and but for his genius, the greater number of Cornish mines, which produced nearly two millions in 1827, must have been abandoned.

Another celebrated person, THOMAS BEWICK, whose talents pursued a different direction to those of the worthies we have mentioned, yet were exceedingly valuable to his generation, worked, in his early life, in a coal pit. He was born in 1753, in Northumberland, and was the son of an industrious collier. He was fortunate enough to obtain some schooling in his youth, and having shown a great taste for drawing his father apprenticed him to an engraver. His abilities soon became so remarkable that he was employed to illustrate the most popular works of the day, one of the principal being a "General History of British Quadrupeds." This raised his reputation far above that of the best engravers of his time, and so great was his genius, that he has been called the *reviver* of wood engraving. His last work was, singular to state, called "*Waiting for Death*," and represents an old worn-out horse, with great pathos and truth. It was designed to assist in the prevention of cruelty to animals, and he died a few days after receiving the proof of the engraving.

Bewick was, in every respect, a good man. The following letter written to one of his pupils, William Harvey, will show you how eminent abilities may be allied to a humble and devout spirit, the best casket for the richest jewels.

"I sent you, last night, the 'History of British Birds,' which I beg your acceptance of as a New Year's gift, and also as a token of my respect. Don't trouble yourself about thanking me for them, but, instead of doing so, let those books put you in mind of the duties you have to perform through life. Look at them (as long as they last) on every New Year's day, and at the same time resolve, with the help of the All-wise but Unknowable God, to conduct yourself on every occasion as a good man. Be a good son, a good brother, (and when the time comes) a good husband, a good father, and a good member of society. Peace of mind will then follow you like a shadow, and when your mind grows rich in integrity you will fear the frowns of no man, and only smile at the plots and conspiracies which, it is probable, will be laid against you by envy, hatred, and malice."

WILLIAM SYMINGTON, the inventor of the first practicable steamboat, was also connected with mining in his early years. He was born at Leadhills, in Scotland, in 1763. His father was a practical mechanic, who superintended the engines and machinery of the Mining Company at Wanlockhead, where one of Watt's pumping engines was at work. Young Symington was naturally of an ingenious turn, and at an early period he seems to have conceived the idea of employing the steam engine to drive wheel carriages. His father and he worked together, and by the year 1786, when the son was only twenty-three years of age, they succeeded in completing a working model of a steam carriage for roads. Mr. Menson, the manager of the mine, was so much pleased with the model, the merit of which principally belonged to young Symington, that he sent him with it to Edinburgh for the purpose of exhibiting it. But this engine was not destined to be applied to road locomotion. He was diverted from employing it for that purpose by his connection with Mr. Millar, of Dalswinton, who was making experiments on the application of mechanical power to drive his paddle-boat. Symington now saw how his engine might be made available for this purpose, and in 1801, constructed one for the *Charlotte Dundas*, which was the first practical steamboat ever built. This eminent man died in 1831.

Another illustrious name in connection with mining is William Fairbairn, one of the most eminent mechanical engineers of the age. He was born at Kelso, in Scotland, in 1787, his father occupying a humble but respectable situation as gardener. Like many other great men, Fairbairn had but few advantages of early education, his chief instruction being derived from a parish school. His first employment was on the fine new bridge at Kelso, where, at fourteen years of age, he carried hand-barrows of stone, but he was not strong enough for this work, and soon after obtained a situation on the coal mine of Percy Main, near Newcastle. Here he had to take coals from behind the screen to the pitmen's houses, and here, we are told by Mr. Smiles, that his Scotch accent, and, perhaps, his awkwardness at first, exposed him to much annoyance from the "pit lads," who were a very rough and profligate set, and as boxing was a favourite pastime among them, Fairbairn had to fight his way to their respect, passing through a campaign of no less than seventeen pitched battles, a mode of rising in the world which I am sure you would not like to practice yourself, but Fairbairn was bold and sturdy, and had been reared in a hard school. He was determined not to be vanquished, and proved himself a hero in the coal-pit, for he had a fierce battle with one of the noted boxers of the colliery and having thrashed him soundly was thus relieved from persecution. At the age of sixteen, he was apprenticed as an engineer for five years to the owners of the colliery, and was placed under the charge of the principal engineer of the mine. Here he had eight shillings a week for wages, but added to his means by overwork, and was able to assist his family, thus preparing himself by industry and dutiful conduct for the prosperity he was eventually to achieve.

It will be useful and interesting for you to know how this youth of sixteen spent his leisure hours in educating himself, and you will be reminded of what I have told you about his friend George Stephenson, who was of the same calculating and methodical habits. Mr. Smiles states that young Fairbairn drew up a scheme of daily study, to which he endeavoured to adhere as closely as possible,—devoting the evenings of Mondays, to mensuration and arithmetic; Tuesdays, to history and poetry; Wednesdays, to recreation, novels, and romances; Thursdays, to algebra and mathematics; Fridays, to Euclid and trigonometry; Saturdays, to recreation; and Sundays, to church, Milton, and recreation. You must remember that it was the evenings, except Sunday, and when he had no work to do, that he employed thus; much of his "recreation" time, very likely, included working with his tools, for he had a great taste for mechanics. If you read the lives of great men, you will almost always find that one great secret of their success has been unwearied application, mentally and bodily, by which alone excellency in any branch of knowledge can be acquired.

One of Fairbairn's first attempts was the contrivance of a piece of machinery, worked by a weight and a pendulum, that should at the same time serve for a timepiece and an orrery, but want of means and time prevented its completion. He was more successful with the construction of a fiddle, for which a professional player offered him twenty shillings. Fairbairn became charged with the care of the pumps at the mine, and the steam-engine by which they were kept in work.

It was about this time that he became acquainted with George Stephenson, whom he greatly admired. He was accustomed in the summer evenings to take charge of his friend's engine, while the latter went to earn a few shillings extra by heaving ballast out of the collier vessels. These young men little dreamt, at the time, what honours and emoluments awaited them. In after years, when Fairbairn became President of the Institute of Mechanical Engineers, at Newcastle, in one of his addresses he alludes to his early career:—"Although not a native of Newcastle," he then said, "he owed almost everything to that town. He got the rudiments of his education there, such as it was, and that was (something like that of his revered predecessor, George Stephenson) at a colliery. Being self-taught, but with some little ambition and a determination to improve himself, he was now enabled to stand before them with some pretensions to mechanical knowledge, and the persuasion that he had been a useful contributor to practical science, and objects connected with mechanical engineering."

After going through many adventures, all of which Mr. Smiles, in his interesting biography of Fairbairn, has noticed, the young engineer found himself at the age of twenty-four in Manchester; and here it was that he made his name celebrated, especially for his improvements in mill-machinery. Besides this, he was one of the earliest among practical men to show the advantages of iron shipbuilding, now one of the most important subjects that concerns the nation.

In 1831 Fairbairn constructed an iron vessel at his works, and the success of this undertaking induced him to begin iron shipbuilding on a large scale. In the course of fourteen years, he built upwards of a hundred and twenty iron ships. In all matters connected with the qualities and strength of iron he was considered a first-rate authority.

It is singular to notice the rapid growth of an intelligence like that of Fairbairn's, originating under the most unfavourable circumstances, yet by wonderful self-tuition and discernment, becoming so eminent and so useful in his generation.

Another name stands prominent in the annals of science, that of JAMES BEAUMONT NEILSON, who was born near Glasgow in 1792. His first employment after leaving school was to drive a small condensing engine, which his father—a millwright in poor circumstances—had made, in a neighbouring quarry. At the age of twenty-two he was appointed engine-wright of a colliery at Irvine in Scotland, and one of the improvements which he introduced in the working of the mine was the laying down of an edge-railway of cast iron, from the pit to the harbour of Irvine, a distance of three miles. In 1817 he was appointed foreman of the Glasgow Gas Works, and remained there upwards of thirty years; during which he directed his attention to the smelting of iron, and perfected his experiments by his invention of the hot blast for that purpose,—previous to which the cold blast had been adopted, under many adverse principles. Neilson's idea was totally different to that of the ironmasters, which was to supply air as cold as possible for the manufacture of iron, and his theory proved correct.

This invention caused an entire revolution in the iron business of Great Britain, and was described as a wonderful discovery. To give an instance of the value of this invention, I may mention, that the coals in Scotland are generally unfit for cooking, and lose considerably in the process; but by using the hot blast, the coal could be sent to the blast furnace in its raw state, by which a large saving of fuel was effected. Even coals of an inferior quality were, by its means, made available for the manufacture of iron. Through this discovery, employment has been given to vast numbers of work-people, and the wealth and resources of the Scotch iron-districts have been increased to an extraordinary extent.

DR. CHARLES HUTTON, a celebrated mathematician, was the son of a superintendent of mines, and was born in Newcastle-upon-Tyne, in 1737. In his earlier years he was engaged in colliery work, in the humble capacity of a coal hewer, but having strong natural abilities he quickly raised himself from that position and became a teacher, although himself self-taught. His treatises on "Arithmetic" and "Book-keeping" are well known, as well as other works of great merit. At the age of thirty-six he was appointed to the professorship of mathematics at the Royal Military College at Woolwich, and a year afterwards was elected a fellow of the Royal Society. Lord Chancellor Eldon was one of his pupils, at a school he conducted at Newcastle previously.

A name that will be imperishably recorded among the brightest in science, is that of ALEXANDER VON HUMBOLDT, who, although of noble extraction and possessing ample means, yet identified himself with the meanest pursuits, so as to render his name celebrated in these, as in most other branches of science. This great man was born at Berlin, in 1769. His father, whom he lost when he was not quite ten years of age, was chamberlain to the King of Prussia. He studied at the universities of Frankfort-on-the-Oder, Berlin, and Göttingen. His love of natural history was manifested at this period, when he made visits of scientific exploration in the Hartz and the banks of the Rhine, the fruits of which were his first appearance in print. In 1791 he entered the mining academy at Freiberg, and he was afterwards appointed to an office in the mining department, and spent some years in this capacity. The desire to visit tropical climates, however, led Humboldt to resign his office, and devote himself entirely to the study of nature. Here his remarkable discriminating powers, his courage, perseverance, and foresight, rendered his researches of the highest interest.

To enumerate even a portion of the works written by Alexander Von Humboldt would occupy considerable space; they consist of treatises in every department of natural science. His last grand work, "Cosmos," has been universally recognised as one of the greatest scientific works ever published, exhibiting in the clearest arrangement many of the principal facts of the physical sciences, and their relation to each other.

This great and good man died May 6th, 1859.

A name that should not be omitted from our gallery of mining worthies is that of WILLIAM LLEWELLYN, of Mangotsfield, Gloucestershire, who died in 1773, at the age of eighty-six years. This extraordinary man was entirely self-educated; and although he worked as a collier all his life to support himself and family, he possessed uncommon abilities. He was fond of astronomy, and frequently spent whole nights in studying the heavenly bodies. He saved thirty pounds in his youth, and spent the whole in books of science. He read the works of Newton, Halley, and other great writers. He made telescopes and microscopes of every kind, and could calculate eclipses with the greatest nicety.

The following epitaph was written by a friend:—

"Beneath this humble turf there lies
An honest collier, learned and wise;
His mind by love of knowledge fired,
To wisdom more than wealth aspired;
And thought it was a happy lot
To dwell with knowledge in a cot.
To latest life, from early youth,
His search was philosophic truth;
And oft from nightly rest he stole
To seek the charmer of his soul
In nature's book. By nature taught,
He learned to think as Newton thought;

And with an astronomic eye
Measured the rolling orbs on high.
He knew the courses, motions, reign,
Of all the planetary train,
And with precision just and clear
Marked out the order of the year.
To him were nature's treasures known,
And science made them all his own.
What though not wealth nor honoured birth
Distinguished him from men of earth--
What though no state nor lettered name
Enrolled him in the list of fame--
His soul aspired to nobler things,
And left the world to lords and kings.
Content to enjoy the better part—
A knowing head and honest heart.
Accept, O sage, the tribute due
  To worth so simply great as thine,
And let the learned with candour view
  What friendship offers at this shrine."

The history of the origin and enormous wealth of the noble house of DEMIDOFF, in Russia, is very interesting. They are descendants of a very honest, industrious, working miner, whose rise to distinction occurred in a singular manner. He was working in an iron foundry at Toula, where arms were made on a large scale for the Russian Government. Peter the Great, who liked to see everything with his own eyes, and rarely trusted the reports of others, during a journey made in 1696, stopped a few days at Toula, to inspect the manner in which the manufactures were carried on. The Czar had with him a halberd of a superior sort, which had been made abroad; and desirous of having some after the same pattern, he ordered that two of the best workmen who could undertake such a commission should be sent for. Demidoff was the only person who had the courage to present himself before his sovereign, who was so struck with his tall stature and strength of limb, added to a pleasing expression of countenance, that he turned to his attendants and said, "this young man would cut a capital figure among my grenadiers." Demidoff was struck with terror on hearing these words, and prostrated himself at the feet of the Emperor, entreating that he might not be taken from an aged mother, whom he had hitherto supported, and who could not survive his absence. Peter smiled at his fears, and told him that if he could forge three hundred halberds as good as the pattern, he should be let off from military service. Demidoff took courage at these words, and promised the Emperor that in a month he would bring them for his inspection. The workman was true to his word, and produced the weapons, which were even superior to the model. Peter was delighted, ordered him to be paid three times the value of the halberds, and dismissed him with presents, promising to call upon him on his way to Moscow. The Emperor was also true to *his* word, and found Demidoff established in a small workshop of his own, to whom he gave another commission. This time it was to copy a gun of a new and foreign manufacture, which Demidoff again outrivalled, and so pleased the Czar by his industry and cleverness that he made the miner and his heirs a present, for ever, of an extensive district immediately surrounding his humble dwelling, with full liberty to work it for minerals as he might please.

This ground proved the source of immense riches to Demidoff, for it was found to cover some of the valuable veins of iron of the finest quality in Russia. Its produce soon enriched the industrious proprietor; and his son having continued to work the mine, and to explore more ground, was enabled to employ the enormous capital thus acquired, in purchasing additional estates, and amongst others, one in which a gold mine was discovered, which yielded, soon afterwards, upwards of one hundred thousand pounds yearly. At the death of this son, a prodigious patrimony was left to be divided equally among three children, one of whom, Count Nicholas Demidoff, occupied a conspicuous position in Europe for his munificent patronage of the arts and sciences. He travelled through Germany, Italy, France, and England, and visited the mines of these several countries. Not content with acquiring knowledge himself, he selected able mechanics, whom he sent into Russia to aid the carrying of improvements into several branches of industry.

To this family Russia is greatly indebted for the extension and progress of her mining resources. Siberia, especially, owes many obligations to the working miner, who was among the first to develope its rich mines of copper, gold, and silver.

I should also tell you, that when Peter the Great learned how valuable a subject he had rewarded in Demidoff—who employed many thousands of workpeople, to whom he was always a liberal, kind, and just master—he wished to see him elevated to the class of nobles. After some hesitation, the old man consented to receive this further proof of his sovereign's appreciation; and being asked what his arms should be, answered, "A miner's hammer, that my posterity may never forget the source of their wealth and prosperity." Such is humility—

"That low, sweet root,
From which all heavenly virtues shoot."

Another great name that lifted itself from the lower strata of society in our own time is that of HUGH MILLER, justly celebrated as a Christian geologist, who was born in 1805, at Cromarty, in Scotland, and laboured for about fifteen years as a common quarryman, in which capacity he found means to store his mind, by close reading and observation, with those truths of nature of which he became afterwards so extraordinary an exponent. He was descended from a family of sailors, and lost his father by a storm at sea when he was only five years of age. In consequence of this misfortune, he was brought up chiefly under the care of his mother's uncles, Sandy and James, who influenced his taste for natural history, and he also imbibed that love of tradition and anecdote which he afterwards so pleasingly developed. Before his eleventh year he was grafted in all the popular stories that delight our childhood, such as the "Arabian Nights," "Jack the Giant Killer," besides other subjects of a more elevated character. The great English poets and essayists became his favourites afterwards, and before he had attained the age of twenty, he was well-informed in most branches of popular literature and science. With such acquirements he soon emerged from his humble employment, and received the appointment of accountant in a bank established in his native village, a situation which he held for five years. In 1829 he published a volume entitled, "Poems written in the leisure hours of a journeyman mason," which was followed, a few years afterwards, by a new work on the "Scenes and Legends of the North of Scotland," which became highly popular, and went through several editions, besides being re-published in America. His attention was soon drawn to the ecclesiastical controversies that were then agitating Scotland, and his famous "Letter to Lord Brougham" brought him prominently into public notice. In 1840 he became editor of the "Witness" newspaper, published in Edinburgh, and in the course of the same year he published in that journal a series of geological papers, which were afterwards collected under the title of the "Old Red Sandstone, or New Walks in an Old Field," a work of remarkable interest, especially as they contained an account of fossils in a formation believed, until then, to be destitute of them. The value of Hugh Miller's observations, and the impetus he had given to geological discovery, were fully acknowledged by Sir Roderick Murchison, Dean Buckland, and other eminent scientific men. One of the most interesting works written by Hugh Miller is "My Schools and Schoolmasters," in which he gives an account of his own self-education, and the means by which he overcame the difficulties of his position. The "Footprints of the Creator," and the "Testimony of the Rocks," two admirable books, show how well he deserved the appellation given to him of the "Christian geologist." This great and good man, I am sorry to add, came to a sad end, occasioned, it is believed, by excessive study, and the consequent wearing out of the mind. In this condition he put an end to his life at Portobello, near Edinburgh, in December, 1856, leaving a name imperishable in the annals of gifted men.

Among the eminent men who have engaged in mining pursuits I may mention EDMUND HAMMOND HARGRAVES, one of the earliest discoverers of the gold fields in Australia, a man of extraordinary energy and ability. A sketch of his adventurous career is given in the "Men of the Time," and is very interesting. Mr. Hargraves was born at Gosport. His father was a lieutenant in the militia. At the age of fourteen he was launched into the world on the deck of a merchant ship, and he toiled at sea three years, during which he visited most parts of the world. Before he was eighteen years old he became a settler, or "squatter," in Australia, and was a proprietor of cows and bullocks. He was then married; but his means consisted merely of such stock and produce as he could raise. In 1849 he sailed from Port Jackson to San Francisco, journeyed to the gold diggings, and while working there was so struck with the resemblance of the geological structure of the country to that of Australia, that upon his return to San Francisco he wrote (March 5th, 1850) to a merchant at Sydney these prophetic words:—"I am very forcibly impressed that I have been in a gold region in New South Wales, within three hundred miles of Sydney; but unless you know how to find it, you might live for a century in the region and know nothing of its existence." He returned to Sydney in January, 1851, whence he set out on horseback, alone, to cross the Blue Mountains. He journeyed on to Guyong, where he had been eighteen years before, and the neighbourhood of which he believed to contain deposits of gold. Thence he proceeded with a young guide down the Lower Road Creek, a tributary to the Summer Hill Creek, which, again, is a tributary to the Macquarie River, where the resemblance of the formation of the country to that of California could not be doubted. The finding of the gold he thus describes:— "I took the pick and scratched the gravel off a schistose (slaty) dyke which ran across the creek at right angles with its side, and with the trowel I dug a panful of earth, which I washed in the water-hole. The first trial produced a little piece of gold. 'Here it is!' I exclaimed, and I then washed five pans-ful in succession, obtaining gold from all but one."

On his return to Guyong, Mr. Hargraves wrote a memorandum of the discovery to the Colonial Secretary, as a memorial of the event. He then visited the Macquarie River, and, pursuing its bed, satisfied himself of the gold-producing character of, at least, seventy miles of the country, all the way up to the point of his first discovery. His companions next found gold in the Turon, as did also Hargraves in Mitchell's Creek. He then proceeded to Sydney, and communicated his discovery, and upon agreement with the Government pointed out the several localities where gold had been found, and instructed the seekers in the manner of obtaining the precious metal, so that in one week, ten thousand pounds worth of gold was raised upon a spot named appropriately "Ophir." He was then appointed Commissioner of Crown Lands, and having visited the principal gold-fields then being worked throughout Australia, he returned to Sydney, and resigned his appointment, the Legislative Council of New South Wales awarding him a sum of ten thousand pounds for his discovery; the town of Sydney also presented him with a pure gold cup of the value of five hundred pounds, at a public dinner, the governor-general being present. These were not the only tributes of gratitude to the discoverer of the Australian gold-fields; Melbourne and Bathurst contributed their share, besides private testimonials. In 1854, Mr. Hargraves returned to London, and published a very interesting narrative of his successes in a volume entitled "Australia, and its Gold Fields."

The discovery of gold in Australia, had, however, previous to the successful researches of Mr. Hargraves, been anticipated by one of the greatest geologists the world has produced, SIR RODERICK IMPEY MURCHISON, who, in his anniversary address to the Geological Society, in 1844, first predicted that gold would be found in those regions, a circumstance I have already alluded to (page 32). This distinguished man of science has so extensively contributed to the success of mining adventures, that I may introduce a few notices respecting him in this chapter.

He was born in the year 1792, at Tarradale, in Ross-shire. He was educated at Durham Grammar School, and being destined for the army, afterwards went to the Military College of Marlow, and, at an early age, served as an officer in Spain and Portugal. Quitting this profession, he devoted himself to scientific pursuits, and especially geology. "He brought," observes a writer in the *North British Review*, "into the field of science all the ardour of his profession, and, after twenty years of unremitting toil, placed himself in the highest rank of British Geologists. When the more recent formations on the earth's surface had been well-investigated, and it had been placed beyond a doubt that their age could be determined by their imbedded fossils, it became a problem of the deepest interest to extend the same law to the older deposits; to trace the later formations down to the oldest: to describe the formations which contain the earliest traces of organic life, and to distinguish the strata which compose them, from those which had been deposited when no living thing moved among the waters."

It was thus that, early in 1831, Sir Roderick Impey (then Mr.) Murchison, succeeded in establishing what is termed the *Silurian* system, a name derived from the district where he investigated the strata, which was the region of the *Silures*, a tribe of ancient Britons. He pursued his investigations in other countries, and found the same sedimentary strata lying in the earth's crust beneath the old red sandstone in the mountainous regions of Norway and Sweden, in the vast and distant provinces of the Russian empire, and also in North and South America. He explored also several parts of Germany, Poland, and the Carpathians; and, in 1846, commenced a geological survey of Russia, under the countenance of the Imperial Government. The Emperor Nicholas presented him, for these services, with a magnificent colossal vase of Siberian avanturine (an opaque variety of quartz, of a reddish-brown colour), mounted on a column of porphyry, with an inscription; and conferred upon him the grand cross of the order of Stanislaus. In England he received the honour of knighthood. As President of the Geological and Geographical Societies, Sir Roderick Impey Murchison has exercised a great influence on the progress of science, and his addresses, delivered annually, are remarkable for their liberality of sentiment and extensive knowledge. "Perhaps no man living," adds a writer in Chambers' 'Cyclopædia,' "has done more to promote geographical science at home, and kindle the spirit of adventure among the explorers of distant lands." In 1855 Sir Roderick succeeded the late lamented Sir H. de la Beche in the office of Director of the Museum of Practical Geology.

A name intimately associated with the progress of British mining is that of MR. ROBERT HUNT, the Keeper of the Mining Records, and the author of several valuable works on scientific subjects. Mr. Hunt was born at Devonport in 1807, and rose to the eminent position he now occupies, by his own unaided labours and unwearied diligence. He belongs to the ranks of Nature's nobility, the self-made men of our days, of whom so many have worked their way to distinction,—

> ' Oh, that estates, degrees, and offices,
> Were not derived corruptly! and that dear honour
> Were purchas'd by the merit of the wearer,
> How many then should cover that stand bare?
> How many be commanded that command?
> How much low peasantry would then be glean'd
> From the true seed of honour? and how much honour
> Pick'd from the chaff and ruin of the times,
> To be new varnish'd?"

The most popular works of Mr. Hunt are his "Researches on Light," the "Poetry of Science," "Panthea; or, the Spirit of Nature," "Elementary Physics," "Manual of Photography," and a charming work, one of his latest, on the "Fictions and Superstitions of Cornwall." Mr. Hunt (who is a Fellow of the Royal Society) has devoted his attention especially to the chemical influences of the solar rays, and he is the originator of several important and curious photographic discoveries. To him we are principally indebted for a more perfect knowledge than we previously possessed, of the influence of light, heat, and actinism (the chemical heat of the solar rays) on the growth of plants. Mr. Hunt was, for several years, secretary to the Royal Cornwall Polytechnic Society, during which his investigations of mines and minerals, were of great value to that county.

A remarkable instance of what steady perseverance and industry can achieve is exhibited in the life of Sir HUGH MIDDLETON, a citizen and goldsmith of London, towards the close of the reign of Queen Elizabeth, and the commencement of that of her successor. Hugh was descended from a Welsh family of great antiquity, and being one of thirteen children, his father sent him to London to seek his fortunes. As soon as he had acquired sufficient property in his business as goldsmith, he obtained from the "Company of Mines Royal" the lease of a copper-mine, for such only it had been considered, in the county of Cardigan, for four hundred pounds yearly. With a natural inclination for such pursuits, and the aid of some experience (for he had occupied himself much, in the earlier part of his life, in searching for coal near his native place), he applied himself so successfully to mining, as to discover a vein of silver, which is said to have yielded a profit of two thousand pounds monthly. Thus enriched, Hugh Middleton determined to adopt the celebrated scheme, which has made his name famous, for supplying water to London by means of the artificial stream so well known as the New River. This was a stupendous work in those days, when engineering skill was very different to what it now is. The corporation of London had obtained an Act of Parliament, so early as the tenth year of Elizabeth's reign, authorizing them to form an aqueduct from any part of Middlesex or Hertfordshire to the city, but no one had been found with sufficient energy or skill to face the difficulties of the undertaking, even had the means been supplied. It was in 1606 that Middleton came forward, alone, to grapple with the obstacles; the necessary powers were obtained, and two springs, one at Amwell, in Herts, the other called Chadwell, near Ware, were chosen, and on the first of February, 1608, proceedings were commenced. Having united the two streams as near to their respective sources as the nature of the ground would permit, Middleton led it on its winding course, sometimes in deep channels, cut often with enormous labour through stubborn soils; sometimes raised aloft on arches; building over it (a number afterwards considerably diminished) eight hundred bridges of various dimensions, and seldom employing fewer than six hundred workmen. When the line had reached Enfield his means were nearly exhausted. He requested aid from the corporation of London, and to the disgrace of that body, whose interests were so much involved in the completion of the scheme, he was refused. An application to King James was more successful, though that cautious monarch claimed, in return, a moiety of the profits. In a twelvemonth from that time the New River, the sinuous course of which extends thirty-nine miles, was in existence. The cistern by Islington was built to receive its waters, and a splendid ceremony, on Michaelmas Day, 1613, inaugurated their admission into it. This, as you can readily imagine, must have been a proud day for the patient and energetic contriver of the most precious boon that London could then receive. He had struggled through every difficulty, the opposition of friends, the ridicule of enemies, the desertion of those who had promised assistance, added to the want of resources.

On this interesting occasion, his brother, elected Lord Mayor on that day, was present. The procession first began "by a troop of labourers, to the number of sixty or more, well apparelled, and wearing green Monmouth caps, all alike, who carried spades, shovels, pickaxes, and such like instruments of laborious employment, and marching, after drums, twice or thrice about the cistern, presented themselves before the mount, where the lord mayor, aldermen, and a worthy company beside, stood to behold them. After a poetical address from one of the men, ending with

> "Loudly sing;
> And with the crystal murmurs strook together,
> Bid all thy true well-wishers welcome hither."

At these words the floodgates flew open, the stream ran gallantly into the cistern, drums and trumpets sounding in a triumphal manner, and a brave peal of ordnance gave full issue to the intended entertainment.

In 1622, King James knighted Middleton. But, alas for human prosperity! Reverses soon overtook this estimable man. For eighteen years after the completion of the New River there was no dividend whatever, and in the nineteenth, it amounted but to £11 19s. 6d. each share. A share has been sold since that time for *fourteen thousand pounds!* The founder of the gigantic system that rendered useless the sixteen public conduits of London, imperfect in their supply, became embarrassed in circumstances, and died November 21st, 1631, defrauded of the substantial rewards to which he was justly entitled. He was buried in the parish church of St. Matthew, in London. There is an excellent portrait of Sir Hugh Middleton in the Hall of the Goldsmiths' Company, and a few years ago (realizing the old saying, "better late than never") a memorial statue was erected, by public subscription, at Islington.

The inventor of the "Davy," as the "Miner's Safety Lamp" is popularly termed (the principles of which my young readers will find explained in page 68), has a distinctive claim among the "eminent men who have been connected with mining," for previous to the discovery of SIR HUMPHREY DAVY, numerous lives were annually sacrificed to the fatal fire-damp. Many terrible accidents in mines have happened since this invention, and, I am sorry to add, still frequently occur, arising from recklessness, and a want of caution in the use of the lamp by the miners.

It was not until after a fearful explosion in 1812, that efforts were made to prevent these calamities. The Rev. John Hodgson, Rector of Jarrow, near Newcastle, together with a few friends, took advantage of Sir Humphrey Davy's visit to Northumberland, in 1815, to consult him on the best means of protecting the miners. A bottle of fire-damp was afterwards sent to him, and with this he made the experiments which resulted in securing to the miner the most invaluable boon he could possess.

If you should have an opportunity of visiting that admirable institution, the Museum of Practical Geology, in Jermyn Street, London, you will see the identical lamp that was first made by Sir Humphrey Davy, and sent by him to the Rev. John Hodgson. In the memoirs of this accomplished clergyman, is an interesting anecdote of the first introduction of the Davy lamp, on its beneficent mission, in a mine. This occurred on the 9th of January, 1816. I have already explained (page 66) the dangerous expedients resorted to by the miners to obtain light, especially that of the "steel-mill," as it was called. Furnished with a Davy lamp, Mr. Hodgson descended Hebben Pit, and walked through a portion of it, where the dangerous gases had accumulated, and saw his lamp become full of blazing gas, without any explosion taking place. He afterwards approached a miner who was working by the spark-light of a "mill," and who had not the slightest knowledge that such a wonder as the new lamp was in existence. No notice had been given to the man of what was about to take place. He was alone in an atmosphere of great danger, "in the midst of life or death," when he saw a light approaching, apparently a candle burning openly, the effect of which he knew would be instant destruction to him and its bearer. His command was instantly, "*put out the light.*" The light came nearer and nearer. No regard was paid to his cries, which then became wild, mingled with imprecations against the comrade (for such he took Hodgson to be) who was tempting death in so rash and certain a way. Still, not one word was said in reply: the light continued to approach, and then oaths were turned into prayers that his request might be granted, until there stood before him, silently exulting in his success, a grave and thoughtful man, whom he well knew and respected, holding up in his sight, with a gentle smile, the triumph of science, the future safe-guard of the pitmen.

This was a severe ordeal for the poor miner, and was acknowledged as such, afterwards, by the clergyman himself.

You might suppose that such an important discovery as the safety-lamp would have secured the inventor a handsome pecuniary remuneration, and so it would have done had such been his wish, for Sir Humphrey was advised to take out a patent from which he would, in all probability, have realised from five to ten thousand pounds a year; but the character of this distinguished man of science was as noble as his genius was great, and the reply he made was, "that he did not want to be paid for saving miners' lives. It might enable him to put four horses to his carriage, but what could it avail to have it said that Sir Humphrey drives his carriage and four?"

Humphrey Davy was born at Penzance, in Cornwall, where his father was a carver in wood, December 17th, 1779, and received his early education at the grammar schools of Truro and Penzance, where he made himself conspicuous for his talents; a highly retentive memory, and an early passion for poetry, which never forsook him. Another prominent trait of his character was early developed: as a child he would angle, even in the gutters of the street, and only two years before his death, he published his interesting volume, "Salmonia; or, Days of Fly-fishing." At the age of fifteen he was placed as a pupil with Mr. Borlase, a surgeon in his native town, where he prepared himself for graduating at Edinburgh. Having a boundless wish for knowledge, he laid down for himself a course of study, which he followed with such perseverence, that by the time he was eighteen he had acquired the leading principles of botany, anatomy, physiology, and especially natural philosophy and chemistry. An experiment which he made was the fortunate means of drawing him, at the age of nineteen, from obscurity. He had ascertained that sea-weed performs the same part in purifying the air contained in water that vegetables effect with respect to atmospheric air. This fact he communicated to Dr. Beddoes, who was endeavouring to establish an institution, at Bristol, to try the effect of gases in the cure of diseases. A correspondence ensued, in which Dr. Beddoes proposed to

Mr. Davy to suspend his intention of going to Edinburgh, and to assist him in his experiments. He accordingly joined his friend at Bristol, and here carried on a course of experiments on the respiration of different gases that nearly cost him his life, from the personal tests he applied. His reputation became extended, and at the age of twenty-two, he was appointed lecturer at the Royal Institution of London. His eloquence and extraordinary talents procured him crowded audiences, and a few years afterwards he made his greatest discoveries, that have ranked him among the famous chemists of his own, or of any age. The origin of these was contained in his Bakerian lecture, delivered in 1806, "On some chemical agencies of electricity." This was regarded as one of the most valuable contributions ever made to chemical science, and obtained the prize of the French Institute; afterwards came his great discovery that the alkalis, potash and soda, and earth, are compound substances formed by oxygen united with metallic bases.

When he first saw the globules of the new metal *potassium*, his delight is said to have been so great that it required some time to compose himself in order to continue the experiment. Other brilliant discoveries followed, and his fame increased far and wide. In 1812 he was knighted, having married in the previous year, a widow, Mrs. Apreece, who brought him a large fortune. So great was his renown throughout Europe, that when he wished to investigate his new theory of volcanic action, he received permission from the French Government—although England and France were then at war—to visit the continent, and was received there with the greatest distinction by men of science.

A baronetcy was afterwards conferred on him, and, in 1820, he became President of the Royal Society.

This great and excellent man died at Geneva, May 29th, 1829, at the early age of fifty-one. "A short time before his death," says his brother and biographer, Dr. Davy, himself an eminent man of science, being at Rome, he mended a little, and as this process went on, "the sentiment of gratitude to Divine Providence was overflowing, and he was most amiable and affectionate in manner. He expressed frequently the intention, if his life were spared, of devoting it to purposes of utility (seeming to think lightly of what he had done already), and to the service of his friends, rather than to the pursuits of ambition, pleasure, or happiness, with himself for their main object."

What a lesson of humility and patience this should teach us! A great man, whose life had been active and laborious, complaining that he had not done enough to assist his fellow-creatures.

In a journal which he kept, he wrote, at the time of his greatest successes—"Beware of too much prosperity and popularity. Life is made up of mixed passages—dark and bright, sunshine and gloom. Notice the unnatural and excessive greatness of fortune, of Alexander, Cæsar, and Napoleon,—the first died after divine honours were paid him; the second gained empire, the consummation of his ambition, and lost his life immediately; the third, from a private individual, became master of continental Europe and allied to the oldest dynasty, and after his elevation, his fortune immediately began to fall. Even in private life, too much prosperity either injures the moral man, and occasions conduct which ends in suffering, or is accompanied by the workings of envy, calumny, and malevolence of others." Words of truth and wisdom we ought never to forget.

"The man,
Who, in right spirit, communes with the forms
Of Nature—who with understanding heart,
Doth know and love such objects that excite
No morbid passions, no disquietude,
No vengeance, and no hatred—needs must feel
The joy of that pure principle of love
So deeply, that, unsatisfied with aught
Less pure and exquisite, he cannot choose
But seek for objects of a kindred love
In fellow creatures, and a kindred joy."

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LONDON:
BRADBURY, AGNEW, & CO., PRINTERS, WHITEFRIARS.

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